ANCIENT PAKISTAN - AN ARCHAEOLOGICAL HISTORY

Volume I: The Stone Age

MUKHTAR AHMED

The Stone Age

Ancient Pakistan

An Archaeological History

Mukhtar Ahmed

Volume I

The Stone Age

F o u r s o m e   G r o u p

Ancient Pakistan – An Archaeological History consists of the following four volumes, of which *The Stone Age* is the first:

Volume I. The Stone Age
Volume II. A Prelude to Civilization
Volume III. Harappan Civilization - The Material Culture Volume IV. Harappan Civilization - Theoretical and the Abstract Volume V. The End of the Harappan Civilization, and the Aftermath

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 The Stone Age

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Foreword to *Ancient Pakistan – An Archaeological History*



Politically, Pakistan is a new state. Historically, however, its outlines can be traced back to at least 50,000 years. Pakistan is an Islamic state but culturally it is byproduct of a multitude of historical processes, of which Islam is only the most recent component. These

historical processes were primarily the result of geographical and geological features of the land, which have shaped not only her history but prehistory as well. Through these processes, this piece of land, irrespective of its names and political configurations at differing times, emerged as a distinct cultural entity at a very early stage and, as such, it deserves a historical treatment separate from India and separate from Central Asia. This book, spread over five volumes, is a partial answer to this need.

In undertaking this work, I have been all too aware that ultimately this exercise bore upon the existence of Pakistan from the very early times as a unique geographical and cultural reality, of which the Indus Civilization was only one of the several manifestations that are known to the general public. This reality, long ignored, is indeed a cornerstone of the present work. As the reader proceeds with the narration, he or she realizes that age by age, period by period, region by region, cultural traits are born, grow, and change as they interweave with other traits and form institutions, social behavior, cultural values, and technological bases that together make up the prehistory of Pakistan. In this process, the reader also realizes that this history is quite different from that we come across in the east of the Indus Valley or to the north and the west of the Hindu Kush Mountains.

Pakistan has been an area of intensive archaeological research for over a century. In recent times the pace of this research has increased manifold, and despite some major unknown areas, we have reached a stage of knowledge where it is possible to offer a connected account of the prehistory of this land primarily, if not exclusively, on the basis of archaeology. The present work aims to do that. It is, however, much more than a compendium of archaeological data of ancient time, bringing out, as it does, the flow of Pakistan's grass-root archaeological history in all its continuities and diversities.

It is an attempt to sum up the heritage of the remote past of this vast and in so many ways a unique region to which we owe our present e'lan in South Asia. It has twofold ambition, to embrace the remote past of the Greater Indus Region, now called Pakistan, in its entirety and to sum up all that we

know about that past at the present time. It adopts an intellectual approach that is more interpretative than descriptive, placed in a universal frame of reference. Pakistan's history and prehistory has been traditionally told in context with "India" or the Indian subcontinent, often termed as South Asia; this book parts company with its predecessors on several essential points. In the first place, it deliberately confines itself to shedding light on only one geographic area of South Asia rather than attempting to search for some kind of elusive unity in clearly diverse region. Secondly, it concentrates on the history of cultural development rather than on events.

Beginning with the first stone tools in Pothwar in the north of Punjab, the book traces the archaeological history of this land and examines the multiple strands of cultural development that weave the prehistory of this country all the way to its early historic foundations. Among other things, it discusses the basic significance of the prehistoric studies of the Greater Indus Valley, the variegated pattern of the beginning of human existence in Pothwar through the course of the Ice Age; the beginning of agriculture and village life in Baluchistan and western Sind; the evolution of a prehistoric high culture that came to be known as the Indus or Harappan Civilization; the examination of the possible causes of the decay and demise of the Indus way of life and its transformation into a culture which, for lack of any other suitable name, we must refer to as the Vedic transformation. This material has been arranged as follows:

Volume I: *The Stone Age:* This volume deals with the question of the early hominins that populated this land in the remotest past, the stone tool technologies and their transformation with time, and the direction that these traditions were setting for the coming agricultural revolution. Chronological;lie, this volume covers the time period from *ca.* 2 million BC to *ca.* 10,000 BC.

Volume II: *A Prelude to Civilization:* This volume essentially covers the beginning of agriculture and animal domestication in Pakistan, development of farming villages, and the evolution of the Early Indus cultures throughout the Greater Indus Valley, along with the concomitant changes in artifactual technology, the pottery, the art, and the subsistence practices. It leaves the Indus man at the doorsteps of an urban society, namely, the Indus or the Harappan Civilization. This volume covers a time period between ca. 10,000 BC to 2,500 BC.

Volume III: *Harappan Civilization - The Material Culture.* As the title implies, it covers the rise and fall of the material culture of the Harappan Civilization. This volume covers the time period between *ca.* 2,500 BC to 1,800 BC.

Volume IV: *Harappan Civilization - Theoretical and the Abstract*. This volume deals with a few theoretical and abstract issues, such as the language and the script, the religion, the social organization, and the nature of the Harappan state, etc, which could not be dealt in other volumes. Like Volume III, this volume also deals with the time period between ca. 2500 BC and 1800 BC.

Volume V: *The End of theHarappan Civilization, and the Aftermath*. This volume deals with the decay and demise of the Indus Age, the examination of of the various degenerated local cultures that replaced the Harappan Civilization, causes and enabling factors assigned to this decay, and the problem of the advent of the Indo-Aryans in the greater Indus Valley. This material is connected with the time period between *ca.* 2000 BC and the middle of the first millennium BC.

These five volumes cover an immensely long period of time and encompass a large set of archaeological data. A certain level of previous knowledge about the subject is needed to fully

comprehend the material evidence and appreciate the bases of interpretations.This background knowledge is briefly covered in the respective volumes to render them independent readings. For those who would rather start with firmer footings or for those who would like to explore the relevant topic somewhat further, an extensive Bibliography has been attached to each volume.

Given the extraordinary discoveries of human fossils in Africa, the fascinating finds of cave art in Central India, superb specimens of stone tools in Western Europe, and the antiquity of agriculture in the Fertile Crescent, one may wonder, why study the Stone Age record of Pakistan at all? The simple answer is that Pakistan has its own remarkable finds, and it has an archaeological record that rivals in richness those in better known regions of the world. The more complicated and important reply, however, is that Pakistan has a distinctive early archaeological record that challenges many of the models and theoretical frameworks that have emerged on the basis of findings made in other regions. It provides the opportunity to reevaluate, refine and in some cases revise a number of major conclusions concerning our evolutionary history, including the evolution of man; the emergence of modern human behavior; the beginning of sedentism and agriculture; the emergence of social complexity and urbanization; and constantly confronting the problem of incursions by barbarian argopastoral intrusions, which kept this land politically out of balance throughout its history but at the same time benefited it with new blood, new ideas, new socio-economic systems, new religious thoughts, and much more.

Pakistan is of course not just of interest to archaeologists. It is a land of incredible cultural, linguistic, ethnic, and genetic diversity, and its contemporary populations have constituted the focus of a wide range of disciplines, including anthropology, linguistics, history, and population genetics. In these disciplines too, Pakistan has much to offer in terms of general theoretical models and frameworks. Indeed a number of noteworthy studies in the ancient past of Pakistan has been undertaken in the past fifty years or so, taking advantage of the progress made in the disciplines of geology, archaeology, anthropology, linguistics, population genetics, ethnography, biological sciences, sociology, and the like. All of these research areas, however, suffer from two key problems. One is their isolation and lack of engagement with other disciplines investigating this geographical area. The other is the almost universal convention of studying Pakistan as a part of “India”.

This volume constitutes a bold attempt to bring together a variety of these disciplines in the study of Pakistan’s ancient past and to study this region in its own right, not as a part of some hypothetical “India”, nor a part of some nebulous “Central Asia”. This is, of course, a huge undertaking and no one person, no matter how great his or her capabilities, can be expected to do it a justice. Thus, *Ancient Pakistan* can only be viewed as the beginnings of what is hoped will be followed by other more scholarly treatment of the subject.

The term ‘Pakistan’ is a political designation, meant to describe an area containing the modern nationalities of Punjabis, Sindhis, Baluchis, Pashtuns, Kashmiries, Makranis, Muhajirs, Hazaras, and a whole number more. Pakistan is a large landmass, measuring almost a million square kilometers in extent and is the second largest of the seven countries that make up the South Asian region, India being the largest. It is the sixth most populous country in the world. The size of the landmass in itself suggests that there is much to be gained from examining the history of human geography, including population dispersals, cultural interactions of various ages, and deciphering the overall trajectory of human evolution in this unique region.

Pakistan presently contains nearly 180 million inhabitants. The people in this landmass speak at least 25 different languages although almost all of them belong to one single family of languages, the Indo-Iranian. The linguistic diversity of Pakistan is matched by a wide and impressive cultural, tribal, and genetic diversity. For example, here one encounters "African-looking" people (the Makranis) on one hand and distinctly "Mongol-type" population (the Hazaras) on the other. In recent years, geneticists have been particularly enthusiastic about tracing the history of various Pakistani populations, linguistic groups, cultural and regional 'nationalities', and anatomically distinguishable endogamous groups, through mapping their genes and making connections with other world populations. These methodologies and results have been published in journals of diverse disciplines and their tempo seems to be increasing in recent years. The reader will find references to these research works as we proceed with our account in respective volumes.

The *Ancient Pakistan* has been written on historical principles, beginning with the discovery of stone tools of the early hominids in the Pothwar Plateau two million years ago and culminating at the end of the Harappan Civilization some 1500 BC. It is not a linear story but efforts have been made to make it as streamlined as possible. The principal topics in all volumes are mainly dealt with from the perspective of archaeology, aided by anthropology, along with a sprinkling of geology and population genetics. There are several reasons for approaching the ancient history of Pakistan in this way, the most important of which is that there is a dire need for such a narration and no major exposition of this nature so far exists. Secondly, this kind of narrative allows one to present and discuss a range of opinions on the various subjects that are pertinent to the study of ancient lands.

The approach taken here is also a geographical one. This is something that plays an essential part in understanding the regional character of Pakistan's cultures throughout the changing times of the past and its fundamental quality of diversity. The character of Pakistan's changing cultures is as distinct as that of Europe, for example. Like Europe, it comprises a number of cultural and linguistic entities, the composition of which has changed continuously through its long history. One of the distinctive features of Pakistan's cultural history is the way in which it has encapsulated human communities of diverse nature at many different cultural and technological levels, allowing them, to a large extent, to retain their identity but still making it possible to establish inter-community relationships.

These characteristics have given the peoples of Pakistan in prehistory a peculiar flexibility and adaptability of their own. It is evident from a variety of prehistoric data that in changing circumstances the people had within themselves the means, and the intellectual reserves, to deal with the often catastrophic problems that arose in the unpredictable environment of the region. The history has shown that when one means of survival became impossible there was always another.

The basic premises of this work are three. First, it is a fallacy to portray the Indian subcontinent of antiquity as a single geographical and cultural unit of which ancient Pakistan is supposed to have been a part. Archaeological evidence is overwhelmingly against such a proposition. Even a cursory look at the archaeological data would show that the region that is now known as Pakistan always remained shy of India, namely the area that lies beyond the Great Indian Desert, but has had considerable affinity, both cultural and genetic, with Central Asia. Second, ancient Pakistan, consisting essentially of the Indus plains and the surrounding hills and plateaus, started to develop as a culturally interrelated region right from the Stone Age. The large bank of stone artifacts, the nature of lithic technologies, and the newly accumulating genetic data, stand witness to this proposition. This was, of course, the result of its peculiar geography, which provided it with a wall of mountains to its west to

separate it from Central Asia, and a formidable desert, the Thar, to its east to separate it from the rest

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of the Indian subcontinent. Third, ancient Pakistan did not exist in isolation; from the very beginning, it was either a part of the known world or its past can be better understood in context with the prehistory of the known world. This world is by no means confined to "India" or the Indian subcontinent in general but extends long distances to the West. In fact, the world known to the inhabitants of ancient Pakistan was the world more to its west than to its East.

Starting from these working hypotheses, I have attempted to indicate the nature and succession of various cultures, which determined the early development pattern of this land. The evidence is generally archaeological in nature, but, as stated earlier, other disciplines, such as population genetics, linguistics, geology, anthropology, etc., also play their respective role. The geographic area discussed comprises the region within the approximate boundaries of the present-day Pakistan – from the Indo-Gangetic Divide to the Khyber Pass, from the foothills of the Himalayas to the coast of Makran, from the current Indo-Iranian borders to the Runn of Kutch, from the Gomal Pass to the dry bed of the Ghaggar-Hakra River at the edge of Cholistan, and from the rugged hills and valleys of Baluchistan to the vast desert of the Thar. The area between the Ravi and the Sutlej/Beas, although not within the current boundaries of Pakistan, is included as, geographically, it lies within the Valley of the Indus and has therefore been a part and parcel of the Indus cultures in the past. Similarly, a sliver of coastal land in Kutch, essentially the Indus delta, is also included although current political boundaries exclude it.

The superficial observer would sneer that India has had some episodes but no history, and ancient Pakistan and Central Asia had neither episodes nor history. This skepticism is used to justify lack of study and an absence of interest in the ancient past of Pakistan on the part of scholars. It is also used to justify the relegation of this land to a status of the Indian hinterland unless forced by overwhelming archaeological evidence to mention it separately as "northwestern India". It is further used by the intelligentsia of Pakistan to justify the beginning of Pakistan's history with the invasion of Muhammad Bin Qasim, or those of Ghouri, Ghaznavi, and the like at best and with the inception of the Muslim League at worst.

The considerations that follow will show that the absence of episodes does not necessarily negate the existence of history. Judged by the standard of time, this region was thickly populated from the very early times of human existence and these human beings have left a heavy trail of footprints on the sands of time. All we have to do is to reconstruct a history without episodes, which means that it cannot be the same type of history as we are generally familiar with through our school textbooks. The present series of books is a small step in that direction.

Essentially, this work is a narration of the story of the Indus man in his remote past, his struggle for survival, his ingenuity, his accomplishments, his failures, and his capacity to endure. At the end, it is an attempt to dislodge the student of history from the traditional timeline of Pakistan's history and focus his or her attention on its very beginning. It is hoped that this effort will help the reader in thinking about Pakistan as a land of antiquity instead of looking at it only in terms of Muhammad Ali Jinnah, the Muslim League, the Partition of British India, or the playground of various military and civil despots since then.

I have tried to rearrange the available archaeological data in such a way that a comprehensible story of Pakistan's ancient past could be told in context of Central Asia as well as that of the subcontinent. In doing so, if I have been able to wean the reader away from a purely Indo-centric point of view of history and redirect his or her attention to the area of Baluchistan, Sind, Punjab, and the Pashtun country itself and do so with reference to Central Asia and Iran with which this land has had a long-standing historical and cultural relationship, I must consider this whole effort worthwhile.

This is, obviously, a radical change in perception and dissenting voices will definitely be heard. Since it is an unconventional approach and since this point of view is being advocated here with some vigor and enthusiasm, it is inevitable that a great deal of technical detail had to be included. By

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the same token, if the reader detects a sort of missionary zeal in the book, it is inevitable, in fact necessary; it is the very *raison d'etre* of the present work.

One needs patience and a degree of perseverance for reading books on prehistory, archaeology, and anthropology (and now, on archeogenetics) in spite of the initial aura of romance associated with the subject. However, the reader who sticks to the task may find gratification and great satisfaction in sensing, as the author does, the heroic struggle of man to survive, his endless adaptation to the changing environment, and his compulsion or genius for material progress. The story of the early man who inhabited ancient Pakistan is particularly interesting; the presence of human ancestors in the northern Pakistan some two million years ago, their continued adaptation to the radically changing environment, their technological dexterity, as shown in the fashioning of their intricate stone tools, and their artistic abilities as are apparent from the exquisite

paintings on pottery, is an intriguing story in itself.
The extraordinary contribution of the Indus people to the development of agriculture and animal husbandry in the foothills of Baluchistan has not yet been told fully but it has recently started to come to light, albeit grudgingly and albeit hesitantly. The remarkable acumen for city and town planning of the Harappans speaks volumes

about their vibrant culture; their spirit of venture on the high seas still resonate in the word *Mallah* (the Sailor) which is evidently a derivative of the *Meluhha* by which the Mesopotamians knew the Indus people in the third millennium BC; their composition of religious hymns (the *RgVeda*) is undoubtedly the first; and their contribution to the development of Sanskrit and its vast literature is legendary. All this must make an interesting story.

The idea for undertaking this project principally stems from that towering archaeologist of India and Pakistan, Sir Mortimer Wheeler (*Five Thousand Years of Pakistan, Indus Civilization,* among others). Additional inspiration comes from Aitzaz Ahsan's *The Indus Saga,* which in effect is a halfhearted appeal for looking at the history of Pakistan in its own right rather than as an appendix to the history of "India". The process of gathering together material, planning and writing this book imitate Yahya Amjad's book *Tareekh-e-Pakistan - Kadeem Daur.*

This book has not been written for fellow historians; its audience is the inquisitive student of history

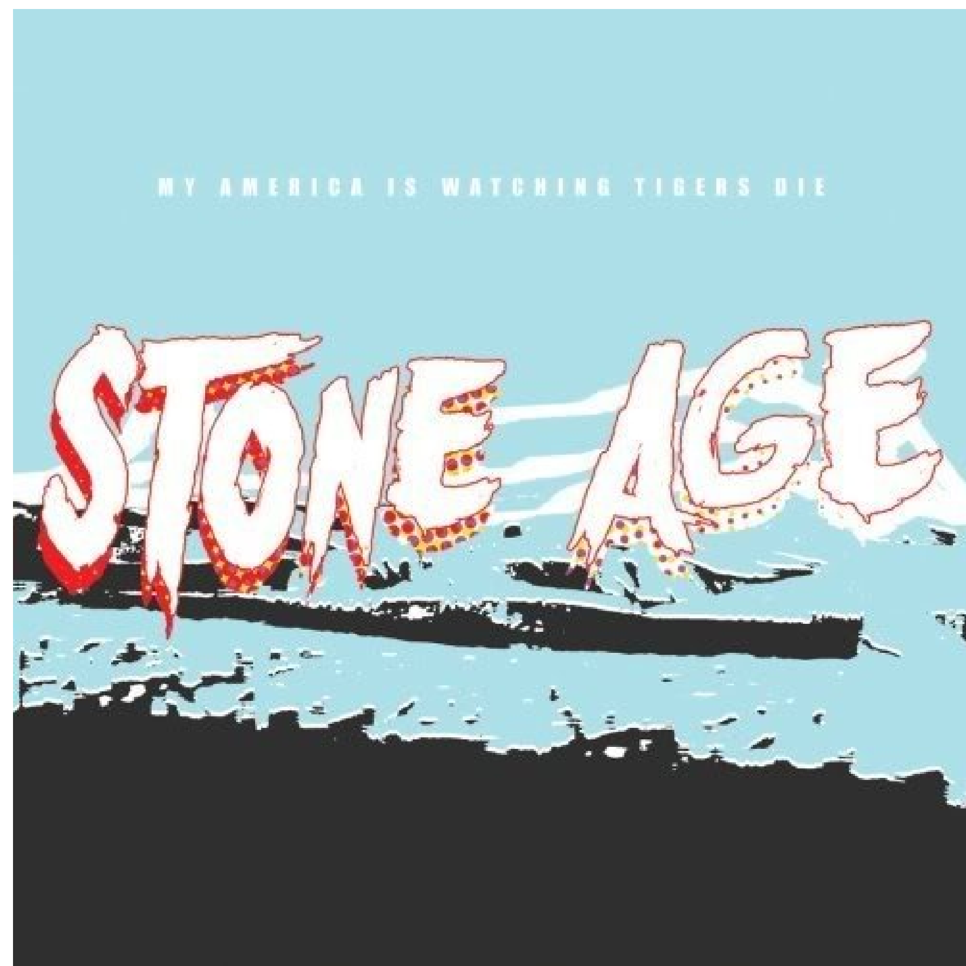
who is interested in looking into Pakistan's ancient past in some detail. The book is also intended for the general reader with an interest in the cultural history of Pakistan, and how it came to be as it did. It may also perhaps be useful to the student embarking on the study of South Asian archaeology or ancient history of this region. It is emphatically not a compilation or compendium of available information; nor does it claim to be comprehensive at the level of theory or ideas within the fields it touches. What I have tried to do is to tell as coherent a story as is possible at the present time, of the development of human life and culture within the region that lies between the Hindu Kush Mountains and the Thar desert, indicating the main trends, principal motivating factors and important turning-points, as we see them on the long road from the earliest toolmakers, over two million years ago, to Early Historic times in the early centuries B.C.

I am aware that what is known today about the remote past of this land is so tentative and fragmentary that it can be critiqued for not managing the subject in a way that comes to approaching completeness or definitiveness. This is, obviously not possible at this stage or anytime soon. Future research will definitely add more details to the subject and the interpretative approaches will surely keep on changing.

Finally, and most importantly, it must be stated and explicitly acknowledged that *Ancient Pakistan* is a synthesis of a large number of excellent writings by world-renowned archaeologists, prehistorians and scholars of related disciplines around the world. Since it is a synthesis, no originality is claimed. My job has been nothing more than putting in order the available information widely spread out in various books and monographs as well as original archaeological reports and research papers. Some of these writings have been extensively reproduced here without putting them in quotation marks, generally giving specific reference to their origins but sometimes, inadvertently, of course) without. However, most of these sources have been listed in the references at the end of each chapter or section. The same applies to various figures, photographs, drawings, and sketches. My gratitude to all these researchers and scholars is, of course, due and I am deeply indebted to all of these authors and publishers.

M.Ahmed

Preface



This volume deals with the examination of the early humans whose ways of life we learn from the stone artifacts, which they or their ancestors fashioned, used and left

behind in geologically stratified contexts. These artifacts date back to several hundred thousands years, before humans developed agriculture and learnt domestication of animals, before they built permanent residences for themselves, and before they started living at fixed locations; in short, a time period which is commonly known as the *Stone Age*. We are interested in the question: where did the people of the Indus Valley come from, how their ancestors migrated from their place of origins to this corner of the world and why and when. An important point of inquiry is also: what role did ancient Pakistan play in the evolution of man, and what is the evidence? All these questions, and some others, legitimately constitute the study of the Stone Age and consequently given ample space in this book.

It is the first volume of the series *Ancient Pakistan – An Archaeological History*; after a brief introduction, it begins with the compulsions of geography and environment, especially the environment that prevailed in the ice ages of the Pleistocene in the greater Indus Valley. Soon, we find ourselves in the midst of man's ancestors who populated a large part of Africa, West Asia, the Caucasus, the Far East, and China. At the same time we notice the presence of man in certain parts of northern Pakistan, especially the Pothwar plateau, and the Peshawar Valley, as well as on the fringes of the Thar Desert and around lakes and streams in the deserts of Sindh. As we ponder over the varied types of stone artifacts that these early humans left for us to prove their existence in this remote past, we notice the emergence of *Homo sapiens*, the modern man, not only in Africa and Europe but also in

other parts of the Old World. In Pakistan, we presume his presence in Pothwar as well as in the Salt Range and the vast expanse of the Lower Indus Valley. This is an interesting but, at the same time, quite involved story.

Essentially, this volume is a cultural history of the peoples of the Indus Valley and the surrounding mountainous regions to its north and the west, from the arrival of the ancestors of early humans *ca*. 2 million years ago to the end of the last ice age, *ca*, 12,000 years ago. The narration of this volume paves the way to the development of agriculture and the emergence of early settlements in Baluchistan and western Sindh, which is the topic of the next volume, namely, *A Prelude to Civilization*. While the cornerstone of the present edifice is archaeology, a disproportionally large space is devoted to genetics, as it is this discipline that is increasingly furnishing us the type of information on the initial colonization of this land and the ongoing interaction of its populations with those of the borderlands.

Like other volumes of this series, *The Stone Age* has been written on historical lines, beginning with the world of great apes and followed by the search for *hominins* of one or more kinds by looking at the stone artifacts found in the exposed folds of the earth of the known age whereupon these artifacts could have been deposited. As we progress in our narrative, we discover stone tools of increasingly intricate designs all over the land and deduce from them the increasing dexterity of man who fashioned them and his ability to travel long distances for the particular rock from which he wanted to fashion his tools. Parallel to this enquiry, we follow the tracks of genes as they move in and out of this region and interact with others from the neighboring populations to create a diversity that is its own. All along these parallel paths, we constantly look for points of correspondence in time and space. Thus, as we detect the first appearance of *Homo sapiens*, the modern man, through the changes in the design of tools, we try to observe if such a juncture is also indicated by a corresponding branching on the genetic tree.

Pakistan's archaeological finds, as they relate to the Stone Age, are rather patchy but bit by bit and piece by piece enough material has been accumulating for some time now and this has made it possible to weave a more-or-less coherent story of biological and cultural development of early humans in ancient Pakistan. We are dealing here with a time period that is truly remote and, because of this, the archaeological record lacks a clearly discernible track of human activities. A lot of conjecture and a hefty web of speculation, therefore, need to be used in weaving this story. This also necessitates our reliance of theoretical models and hypotheses: these serve as a necessary glue for holding the structure together. The narration, as presented in this volume represents all this: some archaeological evidence from Africa and Europe, some evidence from Pothwar and Sindh in Pakistan, some inkling from the neighborhood in the west, some tangible inferences from India and the Far East, some theory, some conjecture, some model-building, and, yes, some speculation.

Compared to the situation in Pakistan and the neighboring lands, a lot of research work has been done in Africa, the Near East, Europe, and more recently in China. This work has yielded a wealth of information about the ancient man, his evolution, his wandering, his industry, his subsistence, and his way of life. All this is quite useful in filling the gaps in our knowledge of ancient humans who made those lands their home. We are tempted, therefore, to look at these studies with great interest. More than that, there is no doubt that humans are a single entity and their past must be common. These are the reasons that we have devoted so much space to Pleistocene climate in western Asia, environment in Africa, human evolution, chronology and routes of human dispersals, comparison of stone artifacts, some aspects of anthropology, and the like. The findings in other regions are the signposts,

leading us to the possible exposition of Pakistan's Stone Age. Without them, we would be wandering without a clue.

There are primarily three types of evidence for the reconstruction of human evolution around the world: fossils and bones, stone artifacts (primarily tools), and genetics (primarily DNA analysis). Pakistan's ancient past is rich in stone tools and this evidence constitutes a major part of this book. The Pakistanspecific genetic studies have so far been few but this gap is being steadily filled, especially through the Genographic and the World Genome projects. We devote a full Section to this evidence The human fossil record from Pakistan is, however, practically non-existing. The situation is not any better in the neighboring regions, namely India, Afghanistan, and Iran. Similarly, not much help is yet available from Central Asia with which Pakistan has been inextricably linked, perhaps since the very first colonization of this region. In the absence of a direct fossil evidence, we do not have any choice but to utilize the evidence from other regions, where such a record is robust, and try to reconstruct the picture

This volume deals with the question of hominins or the ancestors of early humans that populated ancient Pakistan in its remote past. The stone tool technologies and their transformation with time, and the directions these traditions were setting for the coming agricultural revolution is a major component of this narration. This volume also tackles the question of the appearance of the 'modern' man, and the pattern of his dispersal over this land. Since genetics is becoming increasingly important in this quest, the genetic diversity in various existing population groups in Pakistan has been given a prominent place. This genetic diversity provides us with important clues as to the interactions of the various population groups between each other and with those in the borderlands of India, Afghanistan, Iran, and

of ancient man in the Stone Age of Pakistan. We shall therefore spend some time with hominin fossil record in Africa and Eurasia and try to place Pakistan in this larger picture of human evolution and population dispersal.

This volume investigates the cultures of early humans by following the changes in the technology of tool-making that became available to him through the passage of time. The inquiry into the spread of human population is a natural consequence of such an examination. In order to achieve these objectives, the book draws upon information from several sources and from different fields of science, including archaeology, biological anthropology, geology, and genetics, though archaeology

Central Asia.

and genetics dominate all others as the primary sources of information. The objective process is to collect and systematize the available information with the aim of looking at various interpretations about how the modern man evolved, how humans spread on the face of Earth, how the world of foragers, hunters, scavengers, and food gatherers was shaped by the brute forces of nature and how the human evolution was affected by these forces and by the shear genius of man. The ultimate aim is, of course, to determine as to how South Asia in general and Pakistan in particular fit in these development.

The course taken in this study of the cultural history of ancient Pakistan is paleoanthropological on one hand and archaeological on the other. The former refers to an interdisciplinary scientific study of human origins, ancient ways of living, and those

evolutionary forces that help us to understand the place of our species in the natural world. As Kenneth A.R.Kennedy describes so succinctly in his *God-Apes and Fossil Men,* paleoanthropology is not definable by any set of analytical methods or a unified body of theory. Rather, it is in the integrative and holistic character of its orientation to the study of ancient populations that paleoanthropology finds its focus and rationale. Paleoanthropology derives its strength from biology, geology, genetics, ecology, demography, ethnography, linguistics, and a host of other disciplines of study and research but it is most intimately connected with archaeology.

Notwithstanding the fossil evidence from Africa and elsewhere which could be of great use in understanding the evolution of man, our modern understanding of the human past in Pakistan is based ultimately on the examination of stone artifacts and, increasingly, on genetic evidence. The recovery and interpretation of archaeological evidence is a complex undertaking and some knowledge of this scientific disciplines is necessary in order to comprehend the significance of findings. The principal methods and theories involved in this inquiry are dispersed through the book at appropriate places but a few topics have been dealt with separately in an attempt to set the stage for facilitating the recounting of the story in the main body of the book. More or less, the same applies to genetics, more appropriately archaeogenetics.

While Africa holds just claims today as the continent on which our earliest human ancestors evolved, the vast subHimalayen landmass offers scientists the challenge of discovering the evolutionary diversity and adaptations of those human ancestors who moved out of Africa and into Asia a long time ago. Their settlement in northern Pakistan has been established by the recovery of early Paleolithic artifacts, some of which go as far back as 2 million years. Their presence over a long period of Paleolithic times is also indicated in lower Sindh, especially in the vicinity of the Kirthar range, by a large number of sophisticated chert tools and ‘factory sites’ at Rohri Hills. The presence of man did not confine itself within the sub-Himalayan regions and Sindh. The recovery of a middle Pleistocene fossil hominid specimen from Narmada valley in central India proves that the continental India was populated, at least in some pockets, by half a million years ago or even earlier.

It is surprising that despite the fact that Pakistan is where a substantial part of early human history took place in the last two million years, and thus deserved to be treated in its own right as much as that of Europe or Africa, no such account has yet been written; not even a comprehensive review article is at hand. As a result of this neglect, most accounts of early human prehistory of the Old World are biased towards evidence from Europe and Africa, with often only brief mention of what is known from South Asia and even briefer of what is known of “Northwest India”. This neglect becomes more

The first colonization of this vast and varied strip of land constitute one of the major and most exciting themes of human evolution over the last 2 million years, and this is the main focus of this book. Beyond its intrinsic interest, Ancient Pakistan has a wider relevance in paleoanthropology because it was also the land through which hominins had to pass in order to reach India, Australia, and East Asia in general, and the early prehistory of these areas cannot be properly assessed without some reference to developments in Pakistan and its neighborhood.

glaring when, as Robin Dennell points out in the preface of his book, *The Paleolithic Settlement of Asia,* one realizes that Europe is indeed little more than the western peninsula of Asia, and was often a very small tail wagged by a much larger dog. Much of what happened to early humans in Europe in the Pleistocene epoch, before the advent of agriculture and settled life, was an extension of climatic

and faunal developments further east, and better understanding of these would probably benefit perceptions of Europe's own early prehistory.

This book is primarily based on the results of research conducted by a large number of scholars, both Asian and Western but predominantly Western, with respect to the story of human evolution and dispersal. It makes use of the archaeological and geological data that have become available to us during the past century of intense investigations in Africa, Eurasia, and Australia. In recent

years a sizable amount of archaeological and genetic data has also become available from South Asia generally, to which Pakistan has provided its due share. These data are used here to see if the various archaeological findings in this part of the world can be fitted together into the general picture that has been developing in other parts of the World. The picture is still not clear but it is gradually coming in focus.

Muchworkhas been done on South Asian archaeology during the past century and a half. This is evident from the large number of geological surveys and archaeological

explorations that have been undertaken during this period. Almost all of this work has, however, been done from an Indocentric point of view and Pakistan's unique position in the archaeological and genetic record has not been even partially recognized. As a result, the available information about Pakistan's distant past has yet to find its due place in general literature or made accessible to teachers and students.The present volume is a modest attempt in this direction. I have rummaged through the relevant literature and have tried, to the best of my ability, to assimilate the available data, synthesize it in an Indus-specific fashion, and tried to tell the story of Pakistan's remote past in as coherent a manner as possible.

This book does not purport to be an indepth history of Paleoanthropological and archaeological research in Pakistan; rather, it is an effort to integrate the data from a number of prehistoric archaeological sites, their paleoecological profiles, and the processes of adaptation of their people to the changing environment. The presentation of a comprehensive view of the latest information on tools and technologies, subsistence patterns, and distribution of archaeological sites during the entire Stone Age is a daunting task, so is the mapping of human migration and tracking the initial colonization of continents. Important omissions are, therefore, a foregone conclusion. The subject is full of theoretical models, some of them contradictory and a few of them diagonally opposed. With a few exceptions, I have tried to deal with these issues as evenhandedly as possible.

The strict adherence to present-day political boundaries are often problematic and might present a distorted view of the geographical distribution of ancient peoples and their cultural traditions. The inclusion of the studies of the borderlands is therefore quite logical and due weight has been given in this book to such evidence. It applies especially to the age-old ethnic, material, and cultural relationship of the people of Pakistan with those of Afghanistan and Central Asia on one hand and with those of neighboring regions of India on the other hand. In the study of these relationships, Pakistan's cultural and geographic connectedness with the neighborhood has created a lot of problems in archaeological literature and these need to be addressed in order to keep the record straight.

It is well-known that the history and prehistory of Pakistan is strongly connected with that of Iran, Afghanistan and Central Asia but its geographic connection with India is rather weak. This is for the

presence of the intervening desert, the Thar, which separates Pakistan from the peninsular India almost all along their common borders. Given this weak link, it is an unfortunate practice of some archaeologists and paleoanthropologists who routinely talk about the "Indo-Gangetic plains" as though the two were the same, somehow closely related, or even geographically connected, completely ignoring the fact that ancient Pakistan was connected more to the west than to the east. This is evident in its archaeological record as well as in the genetic make-up of its population. I have taken pains, even at the risk of repetition, to highlight this point wherever possible.

Whether the Indus man acquired his changing cultural traits from outside, through some perceived process of diffusion, migrations, and exchange of ideas, goods and genes, or whether these changes were thrust upon him by Mother Nature, are legitimate questions of anthropological inquiry. In this respect, the study of environmental change in the course of human evolution becomes imperative. Considerable attention has therefore been paid to the evidence for the climate change and the resulting biological responses of humans to these changes. Throughout the narration, therefore, the geographical and environmental background of the area has been interwoven with the anthropological aspects of the early human groups.

A book, which tries to combine archaeology, anthropology and genetics and tries to treat the caldron as prehistory, cannot hope to be a systematic treatment of either. What this text does is to give the reader a thorough introduction to selected aspects of each as these bear on the prehistory of the earliest times of humans in Pakistan and its relation to the world of antiquity at large. In this process, the reader will become aware of the ways human culture, biology, geography, and environment are intertwined, each affecting the other in important ways. Our interest, of course, is to see if we can comprehend the prehistory of man in its totality, a prehistory which can be told in an interconnected Naurutive. The reality is, unfortunately, completely different. Our story is rather disjointed and our evidence is somewhat patchy. It is to be expected. First, the archaeological facts about Pakistan and its surrounding region are generally not as well-known as, say, those of Europe. Second, our interpretations of events in this part of the world still dovetails those in Europe. This Eurocentric bent of mind is strong, difficult to counter but still may be out of place. While we cannot do much about the former, we do intend to take issue with the latter when such an opportunity arises.

As with any wide-ranging compilation of researches from different sources and varied intellectual backgrounds, this volume does contain some contradictions of fact, terminology and substantive view points. These inconsistencies do not, however, mean that there are not certain shared goals. In fact, a general reading will show that researchers are united in their desire to address a common set of questions about Pleistocene hominins and the emergence of modern traits, including examination of the relationship between environments and adaptations, the timing and extent of global and regional colonization, the meaning of the similarities and differences in stone tool assemblages, and the methodological problems encountered in dealing with the earliest traces of archaeological evidence, as well as the emergence of anatomical and behaviorally modern man.

Given the growing number of practitioners involved in global Paleolithic research, this volume does not pretend to cover the full range of potential topics and regional studies. I do hope, however, that the material presented here show how to draw upon past scientific accomplishments, transcend some previous limitations, and advance a more holistic and fruitful interpretation of the extant archaeological data base, providing further stimulation to other practitioner. Our interest, of course, is to look at the playground on which the evolving humans exhibited their dexterity in developing the

technologies for making their stone and bone tools, which have become our primary source of information about the lives of their authors.

In the end, it is a narration of the Pleistocene era, the so-called last Ice Age, which provided a unique ecological environment to the early inhabitants of this land, as it did to several other regions of the Old World. The changing culture and the continual improvements in technology cannot be divorced from the environment under which the ancient man struggled and succeeded. The Pleistocene environment and the climatic changes that it represents has, therefore, been given adequate coverage at every step of the narration.

As is obvious, this volume focuses on one region of the world, and as noted in the Foreword to this series, one believes that such attention is justified in light of the wealth of prehistoric resources in the region and its under-study in the field and in global syntheses. Focus on a distinct geographic region also has research merit as it allows analysts to examine how processes are shaped by particular circumstances. Thus, various entries in this volume indicate that the particular environmental, geographic and demographic conditions prevalent in Pakistan helped to shape evolutionary and cultural developments in this region of South Asia. Focus on the region does not mean that this volume is highly particularistic in its outlook however; rather, the regional data is shown also to be informative for investigating general theoretical issues and interregional relationships, including hominid dispersals and population interactions and exchanges.

Before we begin, we must understand that the traditional archaeological terms *Paleolithic*, *Mesolithic*. *Neolithic*, *chalcolithic*, *Bronze Age*, and *Iron Age* do not represent progressive or evolutionary 'cultural stages' in ancient Pakistan or elsewhere in the subcontinent. These terms appear in the text because they are universally understood concepts. They are useful terms in conveying the message through comparisons with similar developments in Africa, Near East, and Europe, of which much more is known at the present time. Employing the same logic, the terms like *Oldowian, Acheulian, hand-axes, cleavers, choppers, etc*, the terms normally used to describe the lithic tools of Europe's Stone Age, has been retained. I do not know how to describe such tools found in Pakistan in any other way. Nevertheless, it must be kept in mind that no strict parallelism of this nature exists between the two. Where the terminology is confusing, the attention of the reader has been drawn to the difference implied.

In writing this book, I have tried to rely upon primary sources and review articles as much as possible. Because the literature on the early prehistory of South Asia is so diverse and scattered, the book includes an extensive bibliography that I hope will be useful to those wishing to proceed further. The primary aim has been to produce a volume that will serve as a source of reference for those unfamiliar with some or most of the archaeological evidence from Pakistan before the advent of agriculture and animal domestication in this region. The narration, however, does not purport to be an indepth history of archaeological, paleoanthropological, and archeogenetic research in Pakistan and its relation to other parts of the Old World: rather, it is an effort to integrate the relevant data from a number of sources into an organic whole and use it to tell a story of human's remote past as best as is possible under the circumstances.

Finally, the reasons for the desirability of an effort such as this volume: these are several. The first, and the most obvious, is that no one has ever taken on himself or herself to put this immense record of human history even in a semblance of order, despite the fact that Pakistan is where a substantial

part of early human prehistory took place in the last two million years. This human legacy certainly deserves to be treated in its own right, as much as that of Europe or Africa. Second, as a result of an ongoing romance with a mythical "India", most accounts of early human prehistory of Pakistan are seen as a part of the "Indian" prehistory and the archaeological data available from Pakistan are often made to fit in the general picture which is supposed to represent an ancient "India". This constant effort to describe the evidence from the Indus plains, the Peshawar Valley, and the Pothwar region in terms of Narmada or the "Indo-Gangetic" plains has distorted the whole picture of the subcontinental history and it needs to be corrected.

M.Ahmed

!**SECTION I**

Setting the Stage

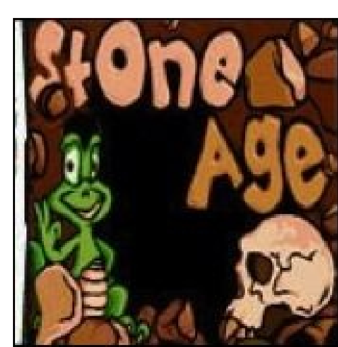
I.1. The Stone Age - An Introduction
I.2. Archaeology, Anthropology and Prehistory I.3. The Land
I.4. The Pleistocene Environment and Climatic Changes I.5. Chronology
I.6. References

I.0. Setting the Stage



This section covers a few peripheral topics which provide a background for the main topic dealt within the body of the book. Thus, it sets the stage for the main act. An extensive discussion is provided about the geography and environment of the land. This is essential for understanding the dynamics of the first human colonization of Pakistan and appreciating the later cultural changes imposed on its early populations by nature and sought by man. Some background information on the ways and means of archaeology and anthropology was deemed necessary as this helps us in telling the story of man in historical sequence. We also devote considerable space to population genetics and the way this discipline has started to shed useful light on the prehistory of man. Of course, suitable background information on the terminology and concepts of stone artifacts is thought to be essential. All this has been discussed in a global context, keeping the path of human evolution and dispersal well in focus.

I.1. The Stone Age - An Introduction



This volume as a whole attempts to chronicle the events of the Stone Age in Pakistan, that is to say, the emergence of humans and their ancestors, their movements, their mutual influence upon one another, their expansions and their eventual settlement during a time period that

archaeologists call the *Neolithic*. It is necessary to pursue these events in space and time in a global context because without some knowledge of them early cultural history of Pakistan and the neighboring lands cannot be properly understood. The modes of life, technology, arts and beliefs of the peoples concerned will also come under discussion as far as some educated guesswork or informed speculations would allow on a local scale. The Stone Age is a layman term; the academic term, used by archaeologists, anthropologists, and prehistorians, is the *Paleolithic*. The term Paleolithic was coined to describe the archaeological cultures of Europe but later applied to most of the Old World. Here we shall use both terms interchangeably.

The Stone Age is a broad prehistoric period during which humans widely used stone for making of tools. It is characterized by the first widespread use of technology in human evolution. Starting from *ca.* 2.5 million years ago, this period nominally ends with the development of agriculture and the domestication of certain animals around 10,000 years ago. It receives its name from the fact that most human artifacts preserved from that era are made of stone
- although undoubtedly tools of wood and animal parts such as bone and sinews were also in use but rarely preserved. The Stone Age, or the *Paleolithic* period, roughly covers a timeline that largely corresponds to the geological timeframe of the *Pleistocene.* The Pleistocene, in turn, is commonly known as the last Ice Age, a time of almost 2 million years duration when the earth was repeatedly subjected to periods of extreme cold, interspersed with relatively warm periods. This corresponds to the early appearance of man on the scene on one end of the spectrum and the beginning of sedentary living on the other.

The later part of the Stone Age is particularly significant in human history as it is during this time that man evolved into his current morphological form and started behaving as we all do. In context of Pakistan or that of the surrounding region, it is difficult to define this 'later part' of the Stone Age in precise chronological terms but we would not be amiss if we take it as a time period between 50,000 years ago and 15,000 years ago. This part of the Stone Age is characterized by refined tools, such as long, slender blades, and the beginning of rudimentary efforts for domestication of plants and animals. It ends with the Epi-paleolithic (*Mesolithic* in Europe).

Stone Age and the Human Evolution: Humans like to think that they have always been the center of the universe, but science has proved that this is not so. This planet and its innumerable species are part of an amazingly long, complex, and continuing drama of evolution, in which human beings made a

very late entry, and have so far played a very minor role. The earth is about 4.5 billion years old and humans appeared on it only some two million years ago; in fact the modern humans just 200,000 years ago and the 'behaviorally modern humans' not earlier than 70,000 years ago. The many advances in the physical sciences in the 20th century have greatly amplified our understanding of the earth's history, while genetic science has unveiled the complex mechanisms that underlay the biological evolution of species. In recent years, advances in DNA analysis have provided important evidence regarding the process of human evolution.

The story of the Stone Age is a story of human evolution as well as the account of man's journey to civilization.

Whatever view one takes of the means and meaning of evolution, the fact that the human stock grew from a creature that walked upright and was ancestral to ourselves cannot be denied. Thus, In order to get to the starting point of the history of Man, we are required to go as far back in time as 2 million years ago or sometimes even earlier, i.e. to the appearance of the first *Homo* of some kind around 2.5 million years ago. It is also important to remember that our species did not only inherit from the past its bodily equipment, dominated by its subtly elaborated brain, but also highly charged emotional centers and all the strange ancient furniture of the unconscious mind. Man emerged, bringing with him hate, fear and anger, together with love and the joy of life in their simple animal form. He also brought the social heritage of family affection and group loyalty. There can be no question that these mental and emotional inheritances which man received from the prehuman past were to provide a most potent force in the creation of culture. We shall find them giving color and form to all aspects of human life other than the purely rational and intellectual.

Although the general idea of biological evolution was known for several centuries (it finds a clear expression in the Ibn-e-Khaldun's *Mukaddama*, a 14th century exposition of the philosophy of history, the foundation of geological and biological evolutionary theories were really laid in the 19th century. Charles Robert Darwin's path-breaking book, *The Origin of Species (1859)* explained how new species arose due to adaptation and how the process of natural selection led to the survival of the fittest. Darwin had been deeply influenced by Charles Lyell's *Principles of Geology* (1830-33) which explained the past changes in the earth's surface as results of still-continuing processes such as wind action, erosion, earthquakes, and volcanic eruptionary theory suggested that change in nature was continuing, unpredictable, and unstoppable.

The Geological Ages and Hominid Evolution: Today, geologists divide the history of the earth into four eras or ages related to the evolution of life forms: *Primary* (Palaeozoic), *Secondary* (Mesozoic), *Tertiary*, and *Quaternary*. The Tertiary and Quaternary together form the Cenozoic or the age of the mammals, which began about 100 million years ago. The Cenozoic is divided into seven epochs, of which the last two - the *Pleistocene* and *Holocene* - are especially important for the story of human evolution. The Pleistocene began about 2 million years ago, and the Holocene (or recent period, in which we live) about 10,000 years ago (see the Table above). The human evolution essentially occurred in these two epochs.

Paleoanthropologists have used fossil evidence to piece together the fascinating story of the biological and cultural evolution of early humans This is not an easy task. It is often difficult to identify a species on the basis of incomplete skeletal material and it is not always clear whether these remains are representative of the entire population of an

ERA PERIOD EPOCH AGE (million FLORA AND FAUNA of years)
Cenozoic Quaternary Holocene 0.01 Modern genera of animals
Pleistocene 2 Early humans and giant mammals
Tertiary Pleiocene 5.1 Culmination of mammalian speciation
Miocene 25

tions. Thomas Henry Huxley's *Evidence as to Man's Place* in *Nature* (1863) extended Darwin's idea of evolution to human beings. The authoritative writings of such scholars ultimately revolutionized prevailing ideas about how and when human beings appeared on Earth. A lot has been written on this topic, many in book lengths. We shall refer to them as we proceed. For further reading, we provide a list of some selected, mostly recent, books in the Bibliography at the end of this volume.

Evolutionary theory have had enormous and unsettling implications, and it is not surprising that many 19th century scholars found it difficult to accept. It ran counter to the Biblical theory of creation according to which nature and humans were created in all their perfection by a divine agency according to a divine plan. It was not easy to accept the idea that reptiles and insects had appeared on the earth long before human beings, or to recognize certain similarities between humans and chimpanzees, or to think of the world as millions of years old. Just as disconcerting was the fact that evoluarea. Nevertheless, different stages in the process of human evolution can be identified, as can the implications of crucial biological markers such as increase in cranial capacity (brain size), changes in pelvic structure and the beginnings of bipedalism (walking erect on two legs), and the modification of dental structure due to changing food habits. Some important aspects of the cultural evolution of early humans include the making of stone tools, the emergence of some kind of social organization, the beginnings of language, and the capacity for symbolic thought.

For many years it was held to be most likely that the earliest human species originated in Asia, probably in some region along the southern slopes of the Himalayas, most likely in the Siwaliks of Pakistan, but it is now generally agreed that the African continent was indeed the birthplace of mankind. The study of human history must, therefore, begin here. Anthropologists estimate that the human lineage diverged from other primates about 5 million years ago, with chimps being our closest

community.[24] **Some anthropologists, such as Adrienne L. Zihlman, propose a reverse version of the hunting hypothesis in which gathering was the driving force behind evolution and female primates**

played a significant part in human evolution.
Setting the Stage
The aquatic ape hypothesis is another theory that seeks to uncover the driving force behind human evolution. In contrast to the two previously living relative. Early members of our own genus,
mentioned theories, the hunting hypothesis and the killer ape theory, the aquatic ape theory claims
technological inheritance, even in the absence of an **that life in aquatic or semi-aquatic settings was responsible for the development of many of the**

Homo erectus, and its near relative, *Homo ergaster*, effective commination, which they somehow passed arose in this region about 2.5 million years ago. **that are not seen in other primates.**[27]on to their next generation. It will be shown in ChapThese hominins migrated outof Africa approxi[27][28][29]ter II.2. that the stone tools that originated in very **not widely accepted by the scientific community. Although the modern Aquatic ape**mately 1.5-2.0 million years ago to found populaearly stages of human existence continued to be

tions in Europe, the Middle East, and Asia, and dis**hypothesis was only developed during the 20th century the concept of humankind arising from an**

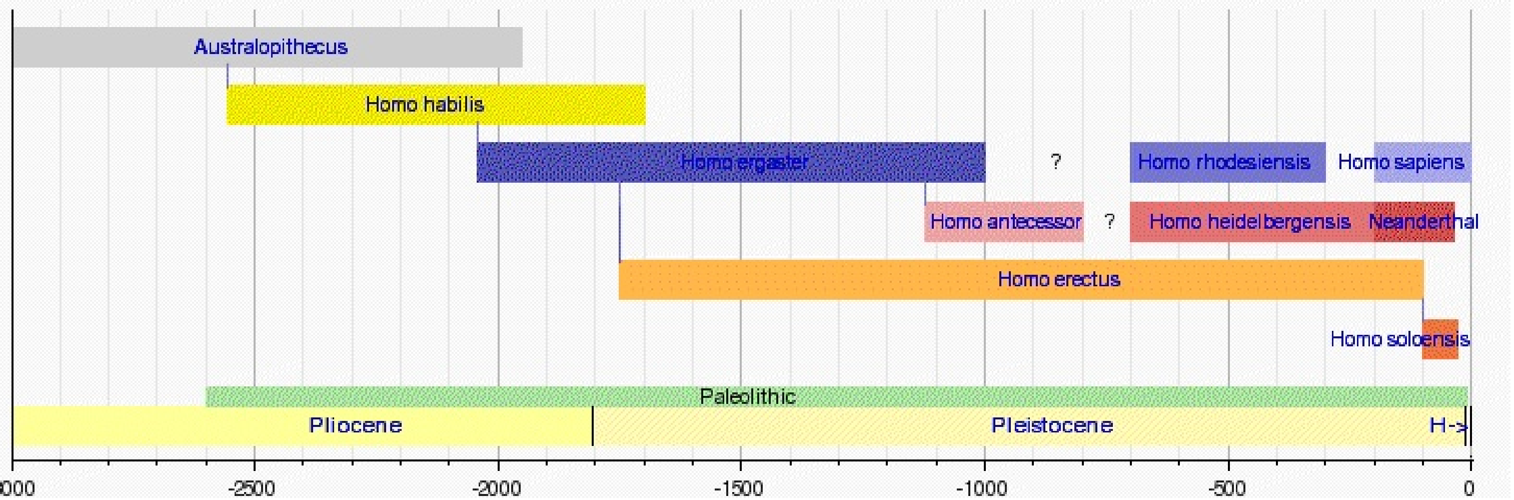
aquatic or semi-aquatic environment is much more ancient, the theories of the Ancient Greek
made and used tens of thousand years after while
new generations continued adding newer types.
philosopher Anaximander who is widely considered to be evolution's most ancient proponent bare How and where modern humans emerged is
Sometimes these technological changes have been
some similarity with the contemporary Aquatic ape hypothesis as he theorized that humans evolveda matter of debate between proponents of two op **Richard Wrangham of Harvard University**sudden (or perceived by us to be sudden) but most
from fish or fish like animals. argues that cooking of plant
posing
theories.
Supporters
of
the
multiregional
foods may have triggered brain expansion by allowing
complex carbohydrates*theory* contend that modern human populations de
frequently they have been subtle and gradual. **in starchy foods to** Age**become more digestible and in effect allow humans to absorb more calories.****Stone Age Technology:** The Stone
[30][31][32]
veloped independently from *Homo erectus* or *Homo* technology essentially consisted of the ability of

ergaster populations in Africa, Europe, and Asia.
Early modern groups evolved in parallel with each
other and exchanged genetic material to give rise to

Simplified human genealogy *dis*
placement theory, commonly known as "out of Af

early humans to make tools. Flint was widely used to make these tools. Hand Axes of different kinds made by chipping away flakes to make a pointed

modern population groups. Supporters of the tool with one or more cutting edges were the most
common. Eventually axes were set into wooden
The timeline below shows a simplified genealogy of Paleolithic humanity, although other ideas of human genealogy exist for the same period:[33]



Timeline scale is in thousands of years.

The above timeline shows a simplified genealogy of Stone Age humanity

rica," contend that modern human populations are Paleogeography and climate handles, making them easier to use. By attaching

derived from a single modern population group that wooden poles to spear points and hardening the left Africa about 80,000-100,000 years ago. This tips in fire, humans created spears that gave them ***Main articles: Pleistocene#Paleogeography and climate, Pliocene#Climate, and*** the ability to hunt and kill large animals. Towards ***Pliocene#Paleogeography*** founding group migrated throughout the Old World, displacing any surviving archaic hominins. By modthe end of the Stone Age, humans made *microliths* -

ern humans, we mean members of our own spetiny stone blades that could be mounted in wooden **The climate of the Paleolithic Period spanned two geologic epochs**

cies, *Homo sapiens* **Pliocene**, who shared with us important

known as the and the Pleistocene. Both of these periods

anatomical features (skull shape and size) and be

havioral attributes (use of blades, bone tools, pig ments, burial goods, art, trade, hunting, and varied environmental resources). Fossils of modern hu mans, dating to 40,000-100,000 years ago, have been found throughout the Old World – Africa, Europe, and Asia – and in Australia. The above pic ture depicts the the timeline and simplified geneal ogy of Stone Age humanity. We shall come back to this subject in some details in Chapter II.2.

Apart from the inheritance of the bodily form, we have the strong evidence for continuity in learned behavior, such as making and using the same types of tools generation after generations, millennium after millennia. While every new genera tion might have contributed their bit of innovation to the manufacturing technology, they retained their

or bone handles. Bones and antlers were also used

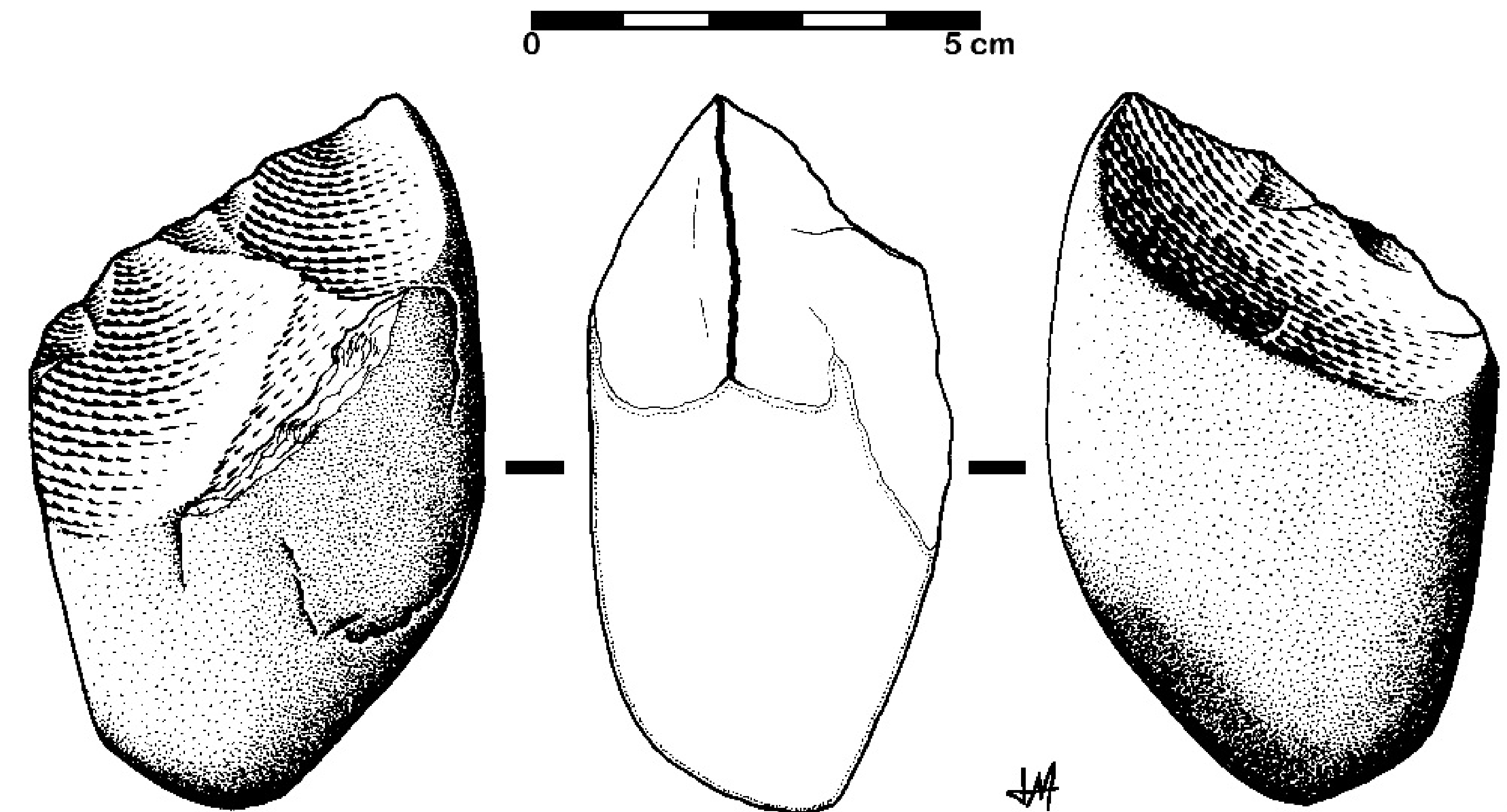
for making a great variety of tools. Bones could be also used to make harpoons in catching fish. Near the end of the Stone Age, there is evidence of even more refined tools, especially bone needles, which could be used for making nets and baskets and even sewing hides together for clothing.

The stone and bone tools served a variety of purposes. Humans used stone weapons to kill animals and butcher their meat. Other sharped edged tools were used for cutting plants, digging up roots from the soil, and cutting branches for building simple shelters. Scraping tools were also used to clean animal hides for clothing and shelter.

The earliest stone tool industry, the Olduwan, was developed by the earliest members of the genus *Homo* such as *Homo habilis*, around 2.6 million years ago in East Africa. It contained tools such as choppers, burins and awls. These tools were completely replaced around 250,000 years ago by the more complex Acheulean industry, which was first conceived around 1.8 or 1.65 million years ago. These implements, in turn, vanished from the archeological record around 100,000 years ago and were replaced by more complex tool kits.

Human groups in different parts of the world began using stone tools at different times and abandoned stone for metal tools at different times. In South Asia the earliest stone tools of Olduvan type, were discovered in the Pothwar region of northern Punjab in Pakistan. These have been

dated to *ca.* 2 million



A typical Oldowan simple chopping-tool.

years ago, almost the same time frame when first such evidence is available from East Africa, an area

that is generally recognized as the ‘cradle of man’. The use of stone tools

continued in this part of the world to as late as the third millennium B.C. although by t h e n c o p p e r tools had started to become available.

Like pottery, the typology of the stone tools provide a chronological framework for

Source Own work

the evolution of man and society. They serve as

Permission

diagnostics of date, rather than characterizing the men or the society. Lithic analysis is a major and specialized form of archaeological investigation, it involves the measurement of the stone tools to determine their typology, function and the technology involved. It includes scientific study of the lithic reduction of the raw materials, i.e. examining how the artifacts were made. Much of this study takes place in the laboratory in the presence of various specialists. In experimental archaeology, researchers attempt to create replica tools, to understand the technological processes involved.

Periodization of the Stone Age: The study of the Stone Age is primarily an archeological endeavor and some sort of chronological system of classification of archaeological remains is essential in order to study them effectively. Archaeologists have therefore divided the Stone Age into different stages, each characterized by different types of tools or tool-manufacturing techniques. The stages also imply broad time frames and are perceived as stages of human cultural development. The most widely used designations for successive stages are

File:Hand axe spanish.gif

From Wikipedia, the free encyclopedia

Size of this preview: 743 ! 600 pixels.
Original file

A typical Acheulean handaxe



shown below.

Description English: Tipycal Acheulean Handhaxe, it has tear form and proceeds from a superficial site in the Zamora province (Spain), in the Douro valley.
Español: Bifaz achelense típico, con forma amigdaloide, procede de un yaciminento superficial de la provincia de Zamora (España), en el valle del Duero
Français : Biface acheuléen tipique, avec silouette amigdaloide; originaire d'un gisement de

Paleolithic (Old Stone Age), *Mesolithic* (Middle Stone Age), and *Neolithic* (New Stone Age). The Paleolithic/Mesolithic/Neolithic division system was first applied only to sites in Europe, but was later referred to prehistoric human development in much of Asia, Africa, and Australasia. The basis of this division is essentially technical (stone tools) but cultural aspects are also important.

Although the use of stone as a raw material for making tools and implements has been ubiquitous in South Asia and some other parts of the Old World till very recent times, we do not treat all of this time period as the Stone Age. Instead, we terminate the Stone Age with the end of the geological epoch of Pleistocene (see Chapter I.4). Broadly speaking, the Stone Age is said to have begun roughly 2.0 million years ago in Africa and ended in most parts of the world around 10,000-15,000 years ago although for some areas an allowance of a few thousand years is often made. During this time humans and their ancestors went through many different stages of biological and cultural evolution.

This division of early history of mankind into Paleolithic, Mesolithic, and Neolithic has served a

useful purpose in correlating the technological developments in one region with those in the other but for some time now there has been a drastic change in terminology. The Neolithic is at present not defined in terms of stone tools but in terms of subsistence and economic conditions. It represents a sedentary way of life, a food-producing prelude to civilization. The invention of agriculture, which first took place about 8000 to 10,000 years ago in the 'Fertile Crescent' and concurrently, or perhaps shortly after, in Baluchistan, brought about dramatic changes in the economy, technology and demography of human societies. It was, in effect, a new beginning for the human race. Because of its distinct character, defined in terms of social and economical terms rather than in terms of stone tool-making technologies, the Neolithic is no longer studied in terms of stone tools and is not included in the study of Stone Age.

The Stone Age is presently understood to include the Paleolithic and the Mesolithic only. This is not to say that stone tools were not the main stay of the Neolithic peoples also. Often, the terms Stone Age and the Paleolithic are used interchangeably, especially by prehistorians, and the Mesolithic is implicitly included in the late Paleolithic or the tail end of the Stone Age. These cultural stages of human development were, of course, not uniform all over the world; they definitely did not correspond chronologically. Within the context of Europe, one assigns the following chronological order to this human journey, a journey of which the Stone Age has been the longest leg.

It must be understood that the traditional archaeological terms Paleolithic, Mesolithic, Neolithic do not represent progressive or evolutionary 'cultural stages' in ancient Pakistan or elsewhere in South Asia. These terms appear in archaeological literature because they are universally understood concepts. They are useful terms in conveying the message through comparisons with similar developments in Africa, Near East, and Europe, of which much more is known at the present time. Employing the same logic, the terms like Oldovian, Acheulian, hand-axes, cleavers, choppers, etc. - the terms normally used to describe the lithic tools of Europe's Stone Age - has been retained by researchers working in other geographical areas also. In fact, we do not know how to describe such tools in any other way. Such a classification is an analytical tool used by scholars to identify patterns across a very long and complex span of the human past and in no way describes actual cultural or chronological periods.

The Paleolithic stage is further divided into the lower, middle, and upper Paleolithic. As shown in the above Table, a general time range for the Lower Paleolithic is from about 2 million years ago to 100,000 years ago, the middle Paleolithic from about 100,000 to 40,000 years ago, and the upper Paleolithic from about 40,000 to 10,000 years ago. However, there is a great deal of variation in dates for different regions and this three-stage classification does not always hold beyond Europe. In fact, as will be seen later, South Asian Paleolithic is not amenable to a threefold classification and according to some opinions the very term "Paleolithic" does not apply. These scholars would rather talk about the Early Stone Age, the Middle Stone Age, and the Late Stone Age when describing the 'paleolithic cultures' in South Asia. Other scholars prefer the use of geological terms (Early, Middle, and Late Pleistocene) to denote the corresponding paleolithic periods (see Table below).

Stone Age cultures did not evolve uniformly in a neat unilinear fashion in any region of the world. This applies to Pakistan as well. There are regional variations in some of their features and their dates also vary considerably. The 'typical stone tool types' column in the table above indicates the tools that are considered characteristic of that particular phase. However, it does not mean that there is complete uniformity in tools found at different sites, or that tools typical of one phase were absent in another.

For example, celts are associated with the neolithic, but are known to occur as late as the historical period in certain parts of eastern India. Similarly, with regard to the subsistence base, it should be noted that hunting and gathering did not come to an end with the beginnings of animal and plant domestication. Many agricultural communities continued to hunt and forage for food. In fact, these subsistence activities continue to be prevalent in certain niches of India even today. It is easier to identify and describe stone tools than to know whether, or to what extent, a community was producing its food

The Stone Age The Early Stone Age (Lower Paleolithic): 2 Million -- 300,000 BC Middle Stone Age (the Middle Paleolithic): 300,000 -- 100,000 BC The Late Stone Age (the Upper Paleolithic): 100,000 -- 20,000 BC **Mesolithic Transi2on:** (the Epi--paleolithic) 20,000 -- 10,000 BC **The Neolithic:** 10,000 -- 3,500 BC

through plant or animal domestication. Sometimes, there is insufficient data to reach a conclusion. Finally, there is the issue of overlap. Although there are some 'pure' neolithic sites in Pakistan and the vast area of Middle Asia, early agricultural sites frequently show an intermixture of Neolithic with copper and copper-alloyed objects.

Lower Paleolithic humans used a variety of stone tools, including hand axes and choppers. Although they appear to have used hand axes often, there is disagreement about their use. Interpretations range from cutting and chopping tools, to digging implements, flake cores, the use in traps and a purely ritual significance, maybe in courting behavior. There are no indications of hafting, and some artifacts are far too large for that. Thus, a thrown hand axe would not usually have penetrated deeply enough to cause very serious injuries. Nevertheless, it could have been an effective weapon for defense against predators. Choppers and scrapers were likely used for skinning and butchering scavenged animals and sharp ended sticks were often obtained for digging up edible roots. Presumably, early humans used wooden spears as early as five

Approximate Chronology of Various 'Ages' and 'Stages'

million years ago to hunt small animals, much as their relatives, chimpanzees, have been observed to do in Senegal, Africa. Lower Paleolithic humans constructed shelters such as the possible wood hut at Terra Amata, near the port of Nice.

FirewasusedbytheLowerPaleolithic hominins as early as 1.5 million years ago. However, the use of fire only became common in the societies of the following Middle Stone Age. Use of fire reduced mortality rates and provided protection against predators. Early hominins may have begun to cook their food as early as the Lower Paleolithic (*ca.* 1.9 million years ago) or at the latest in the early Middle Paleolithic (*ca.* 250,000 years ago).

The Lower Paleolithic homonins, possibly invented rafts (*ca.* 800,000 or 840,000 years ago) to travel over large bodies of water, which may have allowed a group of *Homo erectus* to reach the island of Flores (in present-day Indonesia) and evolve into the small hominid Homo *floresiensis* . The possible use of rafts during the Lower Paleolithic may indicate that Lower Paleolithic Hominins such as *Homo erectus* were more advanced than previously believed, and may have even spoken an early form of modern language. Supplementary evidence from Neanderthal and Modern human sites located around the Mediterranean Sea (*ca.* 300,000 years ago) has also indicated that both Middle and Upper

Paleolithic humans used rafts to travel over large bodies of water for the purpose of colonizing other bodies of land.

Around 200,000 years ago, Middle Paleolithic stone tool manufacturing spawned a tool making technique known as the prepared-core technique, that was more elaborate than previous Acheulean techniques. This technique increased efficiency by allowing the creation of more controlled and consistent flakes. It allowed Middle Paleolithic humans to create stone tipped spears, which were the earliest composite tools, by hafting animals such as wild horses and deer. This ability allowed humans to become efficient hunters and to exploit a wide variety of game animals. Recent research indicates that the Neanderthals timed their hunts and the migrations of game animals long before the beginning of the Upper Paleolithic.

Palaeo-enviremnants: All over the world, the Pleistocene era, which began about 1.8 million years ago, was marked by dramatic climatic changes. The earlier idea of a sequence of four ice ages and four interglacial periods for the higher latitudes has been questioned. There seem to have been more than four ice ages and interglacials, corresponding to alternating periods of cold and

IMPORTANT FEATURES OF THE STONE AGE

TERMINOLOGY Lower paleolithic Middle paleolithic Upper paleolithic Mesolithic GEOLOGICAL AGE Early Pleistocene Middle Pleistocene Late Pleistocene Early Holocene

sharp, pointy stone flakes onto wooden shafts. In addition to improving tool making methods, the Middle Paleolithic also saw an improvement of the tools themselves that allowed access to a wider variety and amount of food sources. For example microliths or small stone tools or points were invented around 70,000 or 65,000 years ago and were essential to the invention of bows and spear throwers in the following Upper Paleolithic period. In some areas Harpoons were used for the first time during the late Middle Paleolithic (ca. 90,000 years ago); the invention of these devices brought fish into the human diets, which provided a hedge against starvation and a more abundant food supply. Thanks to their technology and their advanced social structures, Paleolithic groups such as the Neanderthals who had a Middle Paleolithic level of technology, appear to have hunted large game just as well as Upper Paleolithic modern humans.

During the Upper Paleolithic, further inventions were made, such as the net (*ca.* 22,000 years ago), the bow and arrow (*ca.* 25,000 years ago) and the oldest example of ceramic art, the terracotta figurines found in many areas of the world. Early dogs were domesticated, sometime between 30,000 years ago and 14,000 years ago, presumably to aid in hunting. Archeological evidence from the Dordogne region of France demonstrates that members of the European early Upper Paleolithic culture known as the Aurignacian used calendars (*ca.* 30,000 years ago). This was a lunar calendar that was used to document the phases of the moon. Genuine solar calendars did not appear until the following Neolithic period. Upper Paleolithic cultures were probably able to time the migration of game

TYPICAL STONE TOOL TYPES Pebble and core tools like handaxes, cleavers, chopping tools Flake tools, including those made by prepared core techniques Blade tools made on flakes: parallel-sided blades and burins Microliths

warmer climate. During the cold phases, when ice sheets covered one-third of the earth's landmass,

sea levels fell dramatically. When the climate became warmer, the ice melted and sea levels rose. It is believed that the tropical and semi-tropical regions went through alternating dry and wet phases (interpluvial and pluvial phases), but the rhythm of Pleistocene climatic changes in these parts of the world is not fully understood.

About 10,000 years ago, the Pleistocene era made way for the Holocene era (which continues into our own time) and the basic climatic patterns that prevail in the world today were established. This does not mean that there have been no significant climatic changes in the last 10,000 years. It is just that these changes have not been as enormous as those that occurred within the Pleistocene. The beginning of the Holocene was marked by wetter climatic conditions than those of the late Pleistocene.

The study of the specific features of palaeoenvironments is a very important part of prehistory. Detailed palaeo-environmental studies are so far available for very few parts of the world. In Pakistan, one of the earliest such studies was conducted in 1935 by H. de Terra and I. Paterson on the Soan (Sohan) river in the Pothwar plateau, between the Pir PanJal and Salt ranges in Pakistan. Their team found a large number of tools, mostly of the middle and upper paleolithic, some of the lower palaeolithic as well. De Terra and Paterson identified five tool-bearing terraces (a terrace is an old bed of a river) of the Soan and tried to correlate these terraces with the theory of a four-fold glacial cycle in Kashmir, and further, with a four-fold European glacial cycle. This framework was extended, through comparisons, to parts of India. Although most of the correlations, sequences, and conclusions of the de Terra-Paterson study are no longer accepted in toto, it marked an important stage in the history of prehistoric research in Pakistan. We shall come to this topic again in a separate and dedicated chapter.

Distribution of Human Occupation : At the beginning of the Paleolithic, hominins were found primarily in eastern Africa, in the Great Rift Valley. Most known hominid fossils dating earlier than one million years before present are found in this area, particularly in Kenya, Tanzania, and Ethiopia.

By1.5-2millionyearsbeforepresent, groups of hominins began leaving Africa and settling southern Europe and Asia. Southern Caucasus was occupied by 1.7 million years ago, and northern China was reached by 1.66 million years ago. By the end of the Lower Paleolithic, members of the hominin family were living in what is now China, western Indonesia, and, in Europe, around the wise *Homo erectus*. There is no evidence of hominins in America, Australia, or almost anywhere in Oceania during this time period.

The technological revolution of the Middle and Upper Paleolithic allowed humans to reach places that weren't accessible earlier. In the Middle Paleolithic, Neanderthals were present in Poland. By 40,000-50,000 BP, first ‘modern’ humans set foot in Australia. By 45,000 BP, humans lived at 61° north latitude in Europe. By 30,000 BP, Japan was reached, and by 27,000 BP humans were present in Siberia above the Arctic Circle. At the end of the Upper Paleolithic, a group of humans crossed the Bering land bridge and quickly expanded throughout North and South America. Northern Eurasia became depopulated during the last Glacial Maximum (27,000 to 16,000 BP), but was repopulated as the climate got warmer and glaciers retreated.

Fates of these early colonists, and their relationships to modern humans, not only in context of the Siwalik but all over the world, are still subject to debate. According to current archeological and ge

Approximate chronology of the Stone Age in Pakistan - Main Events and the Nature of Evidence

Approximate Age issues Nature of Evidence
2-1.2 Million years ago Colonization by early Homo *erectus*
Stone tools from Riwat and Pabbi Hills in Pathway, northern Punjab.
700-500,000 years ago Acheulean tools users Stone tools from Pabbi Hills and Wide-spread area of Sindh
250-200,000 years ago Transition from Acheulean to Middle Paleolithic
Evidence from Onagar in southern Sindh
200-70,000 years ago Middle Paleolithic people Tools from prepared cores in Peshawar Valley and Sindh
70-10,000 years ago
10,000 years onward "modern humans" and their tools

Sedentary living, agriculture, animal domestication, microliths, polished tools Tools from prepared cores, blades, microliths in Sindh, and Peshawar Valley, beginning of sedentary living.

Extensive evidence from Mehrgarh and other sites in Baluchistan, surface surveys in Cholistan, Punjab

Mediterranean and as far north as England, southern Germany, and Bulgaria. Their further northward expansion may have been limited by the lack of control of fire: studies of cave settlements in Europe control of fire: studies of cave settlements in Europe 400,000 years ago. East Asian fossils from this period are typically placed in the genus Homo *erectus*. Very little fossil evidence is available at known Lower Paleolithic sites in Europe, but it is believed that hominins who inhabited these sites were likenetic models, there were at least two notable expansion events subsequent to peopling of Eurasia 2-1.5 million years ago. Around 500,000 before present, a group of early humans, frequently called Homo *heidelbergensis*, came to Europe from Africa and eventually evolved into Neanderthals. Both *Homo erectus* and Neanderthals went extinct by the end of the Paleolithic, having been replaced by a new wave of humans, the anatomically modern Homo *sapiens*, which emerged in eastern Africa circa 200,000 years ago, left Africa around 100,000 years ago and expanded throughout the planet. It is likely that multiple groups of humans coexisted for some time in certain locations. Neanderthals were still found in parts of Eurasia 30,000 years before present, and probably engaged in a limited degree of interbreeding with Homo *sapiens*. Hominin fossils not belonging either to *Homo neanderthalensis* or to *Homo sapiens* geni, found in Altai and Indonesia, were radiocarbon dated to 30,000-40,000 and 17,000 years ago, respectively. This is according to the 'Out-of-Africa' model, mentioned before. According to the Multiregional model, the situation is different.

For the duration of the Paleolithic, human populations remained low, especially outside the equatorial region. The entire population of Europe between 16,000-11,000 BP likely averaged some 30,000 individuals, and, between 40,000-16,000 BP, it was even lower, at 4,000-6,000 individuals.

Coming to Pakistan, or South Asia in general, in sharp contrast to the widespread occurrence of animal fossils all over the subcontinent, the evidence of hominin fossils is at present very meagre in Pakistan and India. There is, however, plenty of evidence for the presence of humans in the Upper Siwaliks, in the north of Pakistan. There is no other place on the Indian sub-continent where analysts can convincingly claim an early hominin presence.

The Riwat locality in the Soan Valley (in the Pothwar region) represents one of the best cases for a Late Pliocene presence of hominins in the subcontinent. A small number of faked pieces were picked

up here which are from a boulder conglomerate context dating to ca. 1.9 million years ago or even more. In a second important locality in the Upper Siwaliks, archeological investigations in the Pabbi Hills has yielded stone artifacts on erosional surfaces of fossiliferous deposits. Flaked pieces were found in 211 locales, mostly consisting of isolated pieces where no more than three objects were found at a single place . Approximately half of the stone pieces were found on exposures dating to 1.4–1.2 million years ago ; 102 were dating to 0.9– 1.2 million years ago; and 198 pieces that belonged to, or that were earlier than, the Olduvai age, *ca*. 1.7–2.2 million years ago. On the basis of this evidence the Upper Siwaliks should certainly take center stage in an investigation of the early colonization of the subcontinent but so far, instead of much effort expended on documenting the age and context of the finds and evaluating the artifactual nature of the stone pieces, this discovery has not caught up with the conventional wisdom in which most of the archaeologists have been happy to steeped in.

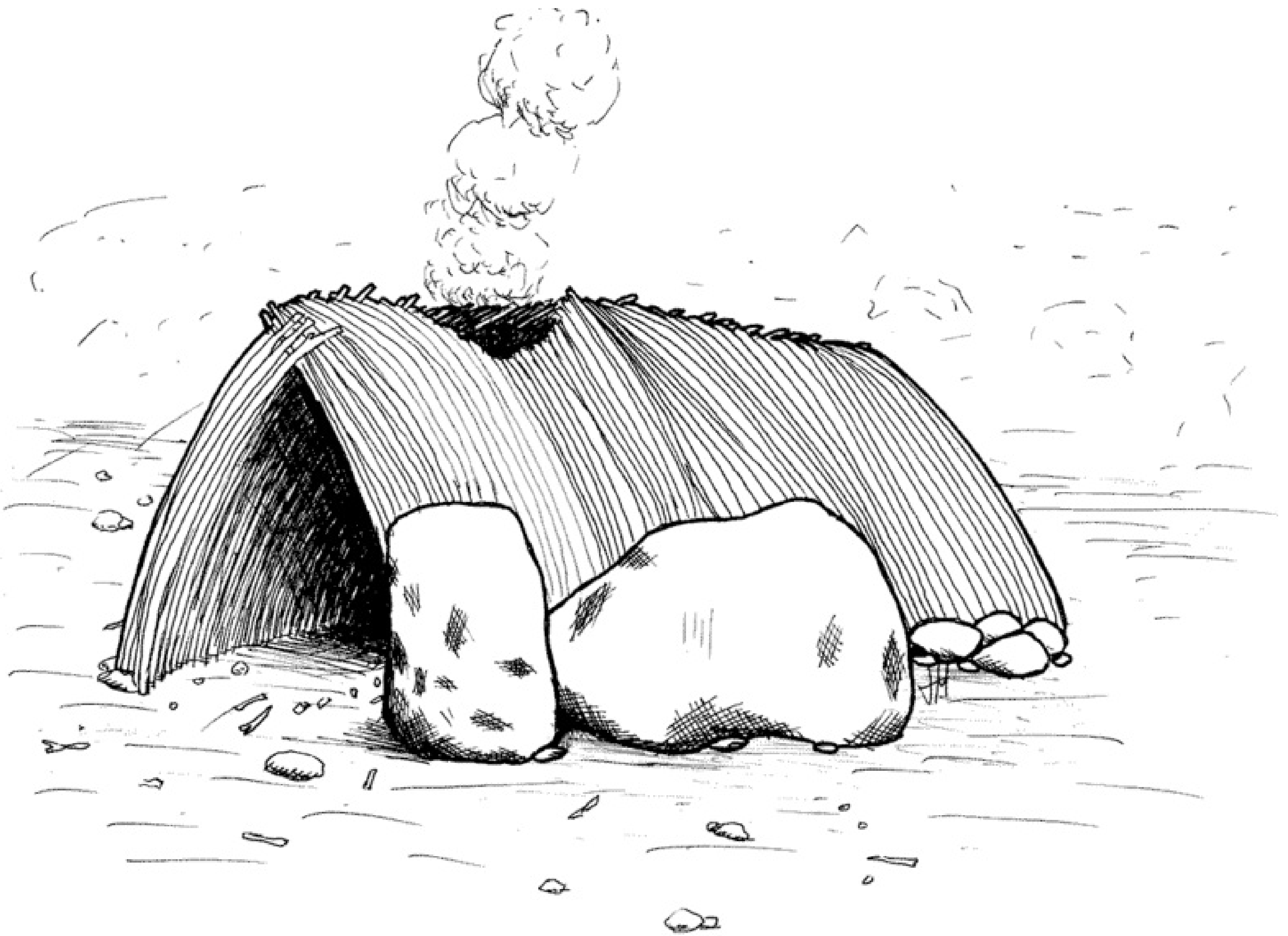
Hominin Remains in the Indian Subcontinent: From the 19th century onwards, several remains of fossil apes were discovered in the Siwalik hills in Pakistan and India. Given rather dramatic names such as Ramapithecus, Sivapithecus, and Brahmapithecus, they came to be collectively known as the 'God-Apes of the Siwaliks'. But, in spite of the clear lithic evidence for the presence of man in the Siwalik Hlls of Pakistan, authenticated early human remains in South Asia are relatively recent. In 1966, Louis Dupree discovered a fragment of a right temporal bone at the cave site of Darra-i-Kur in north-eastern Afghanistan. The deposit in which it was found gave a radiocarbon date of 30,000 ± 1900-1200 before present, i.e., 28,950 ± 1960-1235 BC. The fragment was considered consistent with Neanderthals as well as anatomically modern humans. The associated stone tools seem to belong to a middle paleolithic context. Several cave sites in Sri Lanka - Fa Hien Lena, Batadomba Lena, Beli Lena, and Alu Lena - also yielded remains of anatomically modern humans in contexts ranging between 37,000-10,500 years ago.

Hominin fossils have also been found in central India. In 1982, Arun Sonakia of the Geological Survey of India made an important discovery near Hathnora village on the northern bank of the Narmada, about 40 km north-east of Hoshangabad. Here, embedded in thick, closely packed sandy, pebbly gravel he found a fossilized fragment of a cranium (skull cap) along with some fossils of vertebrates *(proboscideans* and *bovids)* and a few late Acheulian tools. The skull fragment seems to have belonged to a woman about 30 years old. Sonakia suggested that she represented an advanced variety of *Homo erectus* -'advanced' because of her larger cranial capacity range of 1155 to 1421 cc - and named her *Homo erectus narmadensis*. However, according to other scholars, the cranium belongs to an early (archaic) variety of *Homo sapiens*. Its date too is uncertain. One view is that it belongs to the early part of the middle Pleistocene, beginning about 500,000 before present. This date is, however disputed; some archaeologists place this cranium as recent as 300,000 years ago.

The Lifeways of Stone Age People: The life-ways of paleolithic people living in different parts of the world were based on their adaptations to specific environments. However, there were some basic similarities in the gathering communities. modern hunter-gatherers can supplement the information from archaeology, although caution has to be exercised while drawing parallels and conclusions. Paleolithic people lived in shelters made of rock, branches, grass, leaves, or reeds. More or less permanent settlements must be present but none has so far been identified. Other sites indicate temporary camp sites, where people came, lived for some part of the year, and then moved on. A few of such sites have recently been identified at several places in Europe, such as at Terra Amata, near the port of Nice. A few of such sites have also been identified in Sindh, around dried-up lakes. Still

others were connected with specific activities - e.g., kill or butchery sites and factory sites. As mentioned earlier, some 'factory sites' seem to have attracted many different communities over thousands of years. Again, several such factory sites have been lives of these huntingEthnographic studies of located in upper and lower Sidh where the stone Age people extracted high quality chert nodules for their tools.

Thebasicsocialstructureofpaleolithic hunter-gatherers may have corresponded in some ways to what anthropologists call a 'band society', although caution always has to be exercised while invoking ethnographic parallels. Bands are small communities, usually consisting of less than 100 people. They tend to be mobile or nomadic to some extent, moving from one place to another, depending on the seasonal availability of the animals they hunt and the plant food they gather. Members of a band are usually related to each other through kinship, and their division of labour is based on age and sex. The exchange of goods is based on rules of reciprocity, not on commercial exchange. Within the band, no single person or persons 'owns' the natural resources they all depend on. There are no institutions of formal government, no formal or permanent leaders, not even the powerful chiefs seen in more complex tribal societies. The behavior of members of the group is not regulated by force but through customs, norms, and social etiquette.



Depiction of an Early Stone Age hut at Terra Amata, near the port of Nice.

One of the stereotypes about the life of hunter-gatherers is that theirs was a constant, relentless struggle for survival with little or no leisure time. The material desires and wants of paleolithic

humans must have been relatively limited and their technology did not permit them to hoard food beyond a point. These two factors meant that their subsistence-related activities ceased when they had obtained enough food. This must have given them some time for other kinds of activities. Ethnographic evidence in fact shows that not all modern huntergatherers live a hand-to-mouth existence and many of them have plenty of leisure time to sleep, chat, play games, and relax. Another commonly held view is that hunting-gathering is an inefficient mode of subsistence This can be questioned on the basis of the long history of this mode of subsistence and its continuation (of course on a much reduced scale) even into our own time. Further, ethnographic studies have shown that many hunting-gathering groups do not fully exploit the natural resource potential of their area and that they consciously practice sensible restraint in their exploitation of the environment in order to conserve its resources.

Modern hunter-gatherers tend to obtain a significant amount of their food through gathering rather than hunting. This suggests that the 'hunting' part of the term 'hunter-gatherer' has perhaps been over-emphasized by scholars and the 'gatherer' part neglected. This conclusion has important implications for understanding subsistence patterns as well as gender roles and relations in paleolithic societies. In most modern hunting-gathering communities, men hunt and women gather food, and a similar division of labour probably existed in paleolithic times. But if plant food had a greater dietary importance, it can be inferred that women must have contributed in a major way to the subsistence base of paleolithic communities.

Study of the Stone Age: The study of the Stone Age is essentially a study of the Pleistocene epoch, a time period when Earth was repeatedly experiencing long intervals of glaciation interspersed with periods of warmer climates. The Pleistocene epoch is said to begin somewhere between 1.8 and 2.0 million years ago and to end around 10,000 to 12,000 years ago, depending on the geographical location of the region under study. Interestingly enough, Pleistocene is the time period when humans were evolving from some man-like apes or some type of ape-like humans into anatomically ‘modern’ men like us. We do not know if Pakistan played any determinant role in the evolution of man, but it is certain that in the Pleistocene epoch a large part of Pakistan was inhabited by some sorts of humans, probably the so-called *Homo erectus* and archaic *Homo sapiens.*

These ape-like humans fashioned a large variety of stone tools for their use, the styles of which, of course, changed with changing times. A large number of these tools have been discovered all over Pakistan; some of them, as stated earlier, go as far in antiquity as 2 million years ago and some are as recent as five thousand years ago. The examination of these tools and comparing them with those discovered in other parts of the world gives us some idea about the cultural development of humans in different parts of South Asia. In some aspects, these developments were common with those in other parts of the world, especially in Southeast Africa and the Near East, but in some aspects they were unique to this part of the world.

Geographically, the study of the Stone Age touches upon the formation and deformation of the earth crust in several regions of the world, including Pakistan. Archaeologically, it deals with the intriguing pieces of stone artifacts which the early humans made for their use and which they left behind for our musing. Biologically, it covers the anatomical evolution of man from an ape-like bipadel creature to a species more or less like us. Anthropologically, it poses a number of questions about the social and cultural life of early humans and its development and change through time. Over and above, it challenges us with very interesting DNA analyses and begs for our attention in

reconsidering some of our ideas on human dispersal over the face of the earth.

The study of the Stone Age falls under the discipline of anthropology, which is the study of human life and culture from the origins of human life up to the present; and archaeology, which is the study of the material remains of humans and human ancestors. The discipline of genetics is increasingly making inroads into the study of ancient humans and has started to yield valuable leads to human evolution, migrations, and dispersal. Archaeologists seek out, explore, and study archaeological sites around the world where historic or prehistoric people left behind traces of their activities. Anthropologists use the collected data to make theories about how human ancestors lived. Geneticists explore the molecular structure of human DNA of the presentday population groups and try to reconstruct their respective genetic trees. Sometimes their conclusions are at odds with those of archaeologists and sometimes their visualization of primitive existence is at variance with that of paleoanthropologists but oftentimes they are in general agreement. In the absence of a robust archaeological and skeletal record, genetics is a new and extremely useful tool in the study of the Stone Age and its inhabitants. These concerns have given birth to a new discipline, elegantly named *archaeogentics*.

Conclusion: The Stone Age represents the longest part of the human past, and is associated with the emergence of anatomically modern humans and important developments in stone tool technology and subsistence environmental studies form ground for the reconstruction of the life-ways of early humans. The evidence of the lower, middle, and upper palaeolithic phases in Pakistan is gradually increasing, but still largely consists of stone tools. Mesolithic communities fanned out into new ecological niches and the evidence of rock art around Chilas and ostensibly in the Kirthar hills provides valuable information about their lives and aesthetic sensibilities. Palaeolithic and mesolithic people obtained their food through hunting and gathering. The major transition from huntinggathering to food production based on the domestication of plants and animals is associated with the next cultural stage - the neolithic. Some of these topics will now be individually discussed in the main text.

Some of the areas of early human habitation have been researched much more extensively than others and a number of findings from these areas form a common thread that bind the study of the whole humanity into a well-knit fabric. The discoveries in one area help us elucidate and analyze the findings in another area, thus arriving at a common picture of the early man, his means of subsistence, his way of living, his social structure, his strategies. Palaeothe essential backtechnological progress over time, even the anatomical changes in his body and brains. While we discuss the stones collected by archaeologists from the Pothwar Plateau, the Salt Range, Shangao Caves, the Rohri Hills, the plains of Las Bela, and the coastline of Sindh in Pakistan, we take a cue on several aspects of human life in Pakistan from other better-researched areas, such as West Asia and Europe, or even East Africa. Thus, the study of the Stone Age in any one region, by its very nature, draws upon the finings in other regions of the world.

Despite an increasingly large number of Stone Age explorations in Pakistan since 1932, when de Terra and Paterson undertook an extensive geological survey in the Pothwar Plateau, what is known about the Stone Age in culturalenvironmental terms does not amount to much. All that is basically known is the regional stratigraphy with the evolution of, or changes in, tool types. The basic geological and geomorphological background in most cases is, nevertheless, clear. Secondly, there is still no established all-Pakistan geochronological framework within which it should be possible to

visualize all the regional sequences and thus make a chronological and geomorphological comparison between the cultural growths of different areas. Thirdly, the tool types and their manufacturing techniques are usually studied in isolation without any reference to the contemporary environmental settings because the knowledge of the contemporary settings hardly exists except in very general terms. The picture in the borderlands is even more dismal. In view of this situation, we are forced to heavily rely on the cultural-environmental equation formulated elsewhere, mostly in Europe and West Asia. This generalization, coupled with scattered data from different parts of the country, does not, however, deter us to formulate a fairly good idea about the activities of man and his ancestors in this part of the world in its remote past.

Today, geologists divide the history of the earth into four eras or ages related to the evolution of life forms: Primary (Palaeozoic), Secondary (Mesozoic), Tertiary, and Quaternary. The Tertiary and Quaternary together form the Cenozoic or the age of the mammals, which began about 100 million years ago (mya). The Cenozoic is divided into seven epochs, of which the last two-the Pleistocene and Holocene-are especially important for the story of hominid evolution. The Pleistocene began about 1.6 mya, and the Holocene (or Recent period, in which we live) about 10,000 years ago.

I.2. Archaeology, Anthropology, and Prehistory



This book concerns with the story of humans and their ancestors living in Pakistan in its remotest past. Human colonization of this region encompasses a span of at least two million years. This is an awfully long period of time and the signposts which could have helped us in reconstructing this story have withered

away a along time ago. The situation is, however, not as bleak as it appears: archaeology and anthropology come to our aid and recently the discipline of human genetics has started to shed more and more light on the human trail. While archaeology tries to reconstruct a prehistoric story with the help of material objects, such as tools, weapons, ornaments, living structures, etc. that have survived the ravages of time, anthropology looks at the fossilized bones of humans and provides the archaeologist a point of reference in the long evolutionary journey of man. Thus, archaeologists are the real authors of this story while anthropologists providing the plot.

Since we are dealing here with extraordinarily long timescales – up to 2.0 million years, even more, standard methods of archaeology in determining the nature of events and their chronological order fail us here. We turn therefore to geology for learning about the age of the stratum in which the given event was supposed to have taken place or the object of our archaeological interest could have belonged. Population genetics is another branch of science which is increasingly playing a dominant role in defining human evolution and thus helping the archaeologist and anthropologist in getting a new perspective on human history. We devote an entire chapter to this discipline.

Archaeology: Archaeology is the science that studies human cultures through the recovery, documentation, analysis, and interpretation of material remains and environmental data, including architecture, artifacts, biofacts, and landscapes. There is debate as to what archaeology's goals are. Some goals include the documentation and explanation of the origins and development of human cultures, understanding culture history, chronicling cultural evolution, and studying human behavior and ecology, for both prehistoric and historic societies. Archaeologists are also concerned with the study of methods used in the discipline, and the theoretical and philosophical underpinnings underlying the questions archaeologists ask of the past. The tasks of surveying areas of interest in

order to find new sites, excavating sites in order to recover cultural remains, classification, analysis, and preservation are all important phases of the archaeological process.

Within the context of the subject of this book, i.e., the study of the Stone Age, archaeologists largely deal with the objects of stones because these are the only ones that have escaped the ravages of time. The objects of other materials, such as bone, hide, and wood, have long perished. Archaeologists normally use the term *artifact* to refer to the objects that have been modified by human action, either intentionally or unintentionally. The term *tool* is used to refer to something that has been used by a human or a human ancestor for some purpose and may be modified or not. For instance, a thrown rock is a tool, even if it was not modified. It is usually difficult to demonstrate that a particular stone artifact was used as a tool. So, in practice, archaeologists prefer to use the term *artifact* instead, especially in relation to the earlier stages of the Stone Age. Unused debris or waste from the manufacture of stone tools is also considered artifactual.

Stone artifacts are of great importance to archaeologists because they can yield a wide range of information about ancient peoples and their activities. These are, in fact, often the principal archaeological remnants that persist after the passage of time and as such can give important clues as to the presence or absence of ancient human populations in any given region or environment. Pakistan is one of such region, where no human fossils from the Stone Age are at hand and where we have only the stone artifacts of the ancient man to go by. Careful analysis of Stone Age sites can yield crucial information regarding the technology of prehistoric toolmakers, which, in turn, gives anthropologists insight into the levels of *cognitive* (thinking) ability at different stages of human evolution.

In the construction of the history of ancient Pakistan, archaeologists have played a dominant role, sometimes even to the exclusion of other disciplines. While most attention focused on the early Pleistocene or the Lower Paleolithic of the region, the later Pleistocene or the abundant record of the Upper Paleolithic has been pointedly ignored. Stone Age sites are known mainly from surface surveys, some of them providing vital information on settlement patterns, chronology, changes in paleoenvironment, and landscape use. Excavated sites are rare.

Field archaeology relies on observations carefully recorded in the course of surveys and excavations. From this database, ways of life, economic developments and other major factors affecting human societies of the past can be reconstructed to varying degrees of confidence. This constitutes the interpretative segment of the project in hand. The further back in time we go, the more scarce and ephemeral become the surviving material remains and traces of human activity. Thus, the role of archaeology in the investigation of the Stone Age is, obviously, limited. This limitation particularly applies to the paleolithic research in South Asia, including Pakistan. Here serious methodological problems pervade archaeological investigations, as little attention has been paid to high-precision fieldwork and artifact analyses. Nevertheless, archaeological research undertaken in Pakistan's paleolithic past has provided us enough information that we can at least begin to outline the story of the Stone Age in this part of Th.e Old World.

Anthropology: Anthropology, the study of humankind, seeks to produce useful generalizations about people and their behavior, to arrive at the fullest possible understanding of human diversity, and to understand these things that all humans have in common. Physical anthropologists study humans as a biological organism, tracing the evolutionary development of the human animal and looking at the

biological variations within the species today. Cultural anthropologists are concerned with human cultures, or the ways of life in societies. Paleoanthropologists are primarily concerned with the early humans in all their material and cultural aspects.

Paleoanthropology is a special branch of the larger discipline of anthropology. It is not definable by any set of analytical methods or a unified body of theory. Rather, it is in the integrative and holistic character of its orientation to the study of ancient populations that paleoanthropology finds its focus and rationale. Just as archaeology derives its strength from such basic sciences chemistry, and biology, anthropology strength from geology, genetics, ecology, demography, ethnography, linguistics, biology and a host of other disciplines of study and research . At the end, however, it is most intimately connected with archaeology.

Anthropologists normally look for bones and fossils of old inhabitants of the earth and they use them to trace the physical evolution of men and animals. Human fossils are, unfortunately, totally absent from the scene in Pakistan till the advent of the fourth millennium B.C. The situation in the neighborhood is equally dismal as only one fossilized partial skull has been found in India and some fragments of a skeleton are at hand from Afghanistan. This situation is quite different from that of Afas physics,

derives its rica, Europe, and Southeast Asia where a large number of human fossils have been found. This gap in the prehistory of man in Pakistan is, however, being gradually filled through genetic studies, which are likely to provide the answers to many still unanswered questions about human evolution in this part of the world.

Geology: Geology is the science of the birth and growth of, and changes in the earth we live on. It includes the study of the organisms which inhabited our planet. A very important part of geology is the study of how Earth‘s materials, structures, processes and organisms have changed over time. As will be seen later, geological surveys of northern Punjab in 1932-35 is in effect the starting point in the paleolithic research in Pakistan. It is through these geological surveys that a window to the Stone Age was opened up. The application of geological concepts is particularly useful in the study of the Stone Age because the former deal with the extraordinary long periods of times in which the events of the Stone Age have taken place. We also have paleoclimatology and geomorphology, both studying changes in the earth‘s environments over time. Zoology and botany, which study the origins and histories of animals and plants, are partners in tis quest.
Genetics: Genetics in general and population genetics in particular is a relatively new scientific discipline, which is currently undergoing a major growth spurt in the service of prehistory of man. A more particular branch of genetics is *archaeogenetics*. Archaeogeneticists study genetic material drawn from living populations and create their historical interpretations in several ways, mainly by reconstructing the molecular ages and dispersal geographies of lineage within mitochondrial DNA (mtDNA) and the non-recombining portion of the Y chromosome, or by comparing populations in terms of multiple genetic systems within their recombinant nuclear DNA. Like comparative linguists, therefore, ar-chaeogeneticists draw their data from the present.

Archaeogenetics has become an important tool in the study of prehistoric man. It is one of the most versatile tool in the mapping of human migrations tens of thousand years ago. Since it is a new field, it is still seeking its bearings. Although its contribution to the study of prehistory of man is tremendously important, its verdict is still subservient to archaeology and anthropology. Because of

its strong bearing on the prehistory of man, we devote a full chapter to the fundamentals of genetics and their possible application to the study of the prehistory of man.

Prehistory: The study of cultural development of a people has been a major objective of prehistory. The focus has, however, recently shifted to incl.de the relationship of cultures to their surroundings. Food gathering, hunting, fishing, and agriculture, and long distance communications and their development through time - all began to be considered as being within the scope of prehistory and thereby that of archaeology, anthropology, and genetics. More recently, the evolution of man, the dispersal of human populations over the face of Earth, and the formation of various ethnic, racial, and linguistic groups have also started to come under the purview of the prehistory of a region. Historical interpretation derived from regional data and evaluated through a global perspective should be the goal of a student of prehistory. Thus, as we study the happenings within ancient Pakistan, we are on the lookout to see what was happening around our main area of interest. This may be an incomplete story, sometimes a speculative enterprise only, but it is interesting nevertheless.

The study of prehistory is ultimately concerned with the genesis of civilization: how man‘s remote past led to the origin of that way of life whose complexity man has struggled to encompass ever since. The evidence consists largely of the artifacts of daily life, especially the tools and weapons that related to the finding and preparation of food. Consequently, many attempts at reconstructing prehistoric life are dominated by scenes of naked or semi-naked individuals crouched over a fresh kill or squatting by a campfire gnawing at the food. Such scenes, however, deny the prehistoric man the cultural sophistication, which must necessarily have existed if civilization was to emerge from an essentially barbaric way of life. The beginning of agriculture and domestication of animals, the start of permanent settlements, the emergence of farming villages, the communications and incipient trade between these settled communities, and their transformation into town and cities, speaks itself for the presence of culture in human communities and its development with time.

The studies of prehistoric man necessarily emphasize his material side, for that side is most evident in the surviving bone and stone, which represent him. It is relatively easy to demonstrate a prehistoric development of technology and to argue for stages of material development or for markedly different cultures, from the wandering days of primitive scavengers to the sedentary stabilities of the food-producing farmers. It should be evident, however, that economically determined stages of prehistoric life might also have marked stages in the growth of human awareness, of the development of thought, and the recognition of his place in the known cosmos. This intangible prehistory, the preamble to civilization, is, however, difficult to prove by evidence. Imagination and conjectures must be applied and comparison with known and living primitive societies in some other parts of the world must be exercised.

Changing Approaches: During the last several decades South Asian prehistory has moved into a new phase and several authors have quite aptly summarized them in their writings, a few of them in book lengths. Previously the majority of prehistorians working in the subcontinent were concerned with artifact typology and technology, its development through time, and the sequential and regional relationships of assemblages of stone and ceramic artifacts. Recently, owing both to new approaches beginning to be adopted by prehistorians of the subcontinent and to advances in related fields, particularly geomorphology, paleontology, paleobotany and paleoclimatology, throughout the world, there has been an increasing swing towards considering past cultures in their totality. This means finding out as much as possible about the ecological relationship between a human community or

group and its environmental context. As a result, artifacts are seen as only one aspect, although an important one, of any culture. This approach necessitates taking into consideration many other categories of evidence including the study of all animal, plant and other organic remains in associated cultural or geological deposits, thus giving an insight into the character of the immediate physical environment, and the way in which it was utilized. Complementary to this is the relationship of objects including both artifacts and organic remains, to one another at living sites and factory areas. The distribution of sites in relation to the topography of an area or region is another important line of enquiry, and allied to it is the evidence for widespread change in the environment that such topographic or geomorphologic studies provide. This in turn leads to the even more fundamental question of major climatic and environmental change which gave many regions of the world a totally different character in the past from that we see today.

Advances in earth sciences generally, and in the geomorphology of arid and tropical zones of the world in particular, are two of the main factors that have made possible the change of emphasis in South Asian prehistoric studies. Paleobotany, which has played such an important role in understanding past climatic conditions in northern temperate regions, has proved less rewarding in South Asia for a number of reasons. Geomorphology, the analysis of topographic features, helpful. Examination shows many features, such as abandoned river courses, glacial moraines, buried soils, fossil desert dunes, and dead drainage systems, that are residual from earlier periods, having been formed under conditions different from those prevailing today.

As Bridget and Raymond Allchin note (2), there is an increasing awareness of the need to study sites of all kinds, including open air factory floors and living sites in relation to environmental factors, and this is beginning to lead to a more careful and systematic approach. Coupled with this is a more realistic understanding on the part of prehistorians of the nature of the environment of diverse regions of South Asia, present and past; and of the ways in which it differs, often radically, from the environment of temperate regions where methods and approaches to prehistory were initially developed. For example, in much of Europe or North America has, however, been more of the present landscape soil tends to form fairly rapidly on all but the steepest slopes, engulfing objects and remains of buildings, etc., and obscuring them from view without necessarily burying them deeply. In most parts of South Asia, where erosion is predominant, objects tend to remain exposed indefinitely in any rocky or hilly situation, with the result that in considerable areas of India and Pakistan structures and artifacts are to be found on the surface, unless disturbed by subsequent human activity. The corollary of erosion, aggradation or the deposition of silt, gravel, etc., produces the opposite effect, and in valleys and plains structures and objects become buried in a relatively short space of time. For example, a single flood may lay down five or ten centimeters of silt over many square kilometers in the lower Indus. This does not happen every year but may take place several times in a decade (2).

Other aspects of the changing approach to the study of human cultures relate more specifically to the problems posed by later archaeological periods and contexts. Here too there has been a general shift away from the older approach to artifacts or categories of artifacts viewed in isolation, towards a more integrated view of cultures as functioning wholes, viewing cultural change as far as possible in much the same way as its modern counterpart in terms of dynamic processes, rather than as mere sequences of artifacts, traits or assemblages. These changes have been relatively slow in reaching South Asia, where it is still not uncommon to come across the either explicit or implicit view that changes in style of pottery, stone tools, or some other artifacts necessarily reflect more profound

changes, such as the arrival of immigrants, rather than mere changes in style or fashion, occurring in much the same way as they still do today.

While there has been many positive changes witnessed through the past two or three decades, there has been some corners that still remain dark. For example, there has been considerable abuse of the availability of language and historical, literary or quasi-historical data, to augment archaeological evidence on the part of some Indian archaeologists who unnecessarily throw in Sanskrit words into archaeological discussion as though the land of the yore spoke that language. Another problem, especially applicable to the investigations of the Stone Age of South Asia, has been the utter neglect of the geographical features that separated ancient Pakistan from the area that is now known as India and the glossing over the intimate relationship that the Greater Indus Valley has had with the areas to its West. This has distorted the prehistory of Pakistan as well as that of India.

The habit of speaking about India and Pakistan in the same breath still continues. This must stop. There is no such thing as 'Indo-Gangetic plains"; there are the Indus plains and there are the Ganga-Yamuna plains, two completely separate entities in two entirely separate regions, having two entirely different climates and two different regimes of rainfall. There is no 'north-west India"; the Siwaliks of Pakistan have very little relation to the Siwalik hills of northern India. The difference between the general climate of Pakistan from that of India must always be kept in mind: one is a desert country, the other is a quasi-tropical and this difference between the two regions have existed through the ages. There is no sense in discussing the archaeology of the subcontinent in tones as though it was a one single geographic and environmental unit.

Archaeologists dimly perceive the processes of cultural change in their collections of artifacts gathered from the earth by one means or another. Anthropologists, especially paleoanthropologists and archaeoanthroplogists, those who are mainly concerned with the studies of ancient humans, look at these col

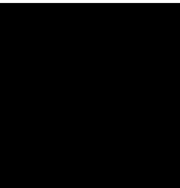
lections, evaluate the observations and try to evolve a mental picture as to how the ancient man lived and functioned in that far away time. Prehistorians take this collective evidence, try to connect it with other evidence through a thread of time, and attempt to create a plausible story. Some of them are prone to grasp too readily at mirages cast up by old sherds of pottery and the paintings thereon, ruined walls and houses, or the stone tools that the primitive man left behind for posterity. Often, they are led into wilderness of speculation. Others, too skeptical to see sub

stance among the shadows, simply count and recount the archaeological findings and are content. Still others strive with every means

at hand to comprehend what clues the archaeologists have in order to resurrect the outlines of a teeming, long dead world but somehow create shapelessness only. All this exposes a sense of complexity and bewilderment perhaps not found in any other discipline. The difficulties in interpretation are immense, and

oftentimes the exercise seems to resemble the efforts of solving an unsolvable puzzle. (paraphrased from Walter A. Fairservis, Jr, *The Roots of Ancient India*)

I.3. The Land



In most of the archaeological, anthropological, genetic, social, and political commentaries,



Pakistan is generally

lumped together with India and then a common nomenclature, namely South Asia and the Indian Subcontinent,

is applied to the aggregate. India and Pakistan have some social, linguistic, and historical factors that are common and they can well be discussed under the umbrella of South Asia or the Indian Subcontinent.

These factors are, however, of recent origins. When we are to discuss the prehistory and protohistory of

the two countries, this approach is fraught with much misunderstanding, confusion and gross inaccuracies.

The term' South Asia' is a political designation, meant to describe an area containing the modern nations of Bangladesh, Bhutan, India, Nepal, Pakistan, Sri Lanka, and the Maldives. It is a large

landmass, measuring about 4.4 million square kilometers in extent. India is the largest of the seven countries that make up the region, measuring 3.3 million square kilometers, or six times the size of France. The term, the 'Indian subcontinent' , on the other hand, is a geographic unit, meant to differentiate the landmass from the rest of the Eurasian continent. One of the most striking features of the subcontinent is the Himalayan mountains, which rise to a height of 8,850 meters at Mount Everest, and provide a nearly impenetrable wall of mountains in the north. The Great Indian Desert, the Thar, which physically separates Pakistan from India, is another distinctive feature along the eastern flanks of Pakistan. While the Narmada, Ganga, Brahmaputra, Godavari, and Krishna cross the vast expanse of India, the Indus and its many tributaries irrigate Pakistani plains.

A number of geological basins are located across the subcontinent, with distinctive rock types and plentiful natural resources. As a result of these differences, certain geographic areas were attractive for early humans on account of their natural resources and ease of travel, whereas other zones were barriers to human settlement. Because of these and other ecological differences in the early history of man, human communities in the subcontinent developed with different pace and followed differentiated cultural trajectories.

Like Afghanistan, Iran, India, and so many other countries, Ancient Pakistan is a geographic construct. Its borders correspond more or less to the political boundaries of the present entity but are more fluid, rather fuzzy. Although a relatively recent nation-state, Pakistan has been one of the major geographic areas of the Old World. It is a vast area wedged between Iran and Central Asia on one hand and India on the other, covering about 900,000 square kilometers of land. The unique geography of the land and an easily recognizable linguistic, genetic, and cultural base notwithstanding, Pakistan is not an island. It is a geographical and cultural part of Central Asia on one hand and of the rest of South Asia on the other hand.

Geographically, Pakistan is a diverse country, ranging from high mountain ranges, to elevated plateaus, hill-slopes, alluvial plains, arid land, sandy deserts, coastal areas, and occasionally forested hills. It has the highest or the second highest mountain peaks in the world, but also one of the lowest earth surfaces in the salt lakes of Kutch. Pakistan is essentially defined by the Indus basin, which drains central Himalayas. It is framed by the Aravalli mountain range and the Great Thar Desert in the east, and the Sulaiman and Kirthar ranges in the Northwest and the West, respectively. The Arabian Sea in the South and the Himalayan Mountains in the North box the land in.

The geographical significance of this country in understanding the evolution and dispersal of humans cannot be overstated, particularly since it has received less paleoanthropological attention than most regions in Asia and Europe have. It lies directly between Africa to the west and Southeast Asia to the east from where the oldest Homo *erectus* specimens have been reported. Another significant fact is that it straddles the *Movius Line*, which represents
Acheulean
the easternmost domain of rich

localities. (see Chapter V.1). So far, there has been no fossil evidence for the presence of early humans in Pakistan but there is much artifactual record that not only stands witness to the presence of hominins in this part of the world quite early on in human history, but also indicates a central role of this area in understanding the evolution of the genus *Homo* in South Asia.

For the paleoanthropologist, the primary significance of Pakistan is that it was probably the largest

contiguous area colonized by hominins west of the Thar Desert. The distances that were eventually covered on foot by bipeds, who were less well equipped and generally smaller than we are, are often hard to comprehend: Ubeidiya and Majuangou, the oldest Stone Age sites yet found in Palestine and China, respectively, are 4,500 miles apart and roughly equidistant from the banks of the Indus River in Pakistan. This evidently puts Pakistan right in the midst of human settlement.

Since the prehistoric data of this region can only be discussed with reference to its current geography, a few topographical features of the land need to be reviewed and put in perspective. Pakistan's geography has been adequately covered by several authors and many of them give a fairly comprehensive outline of the basic physical geography of Pakistan as it appears today. The geographical features of this land in the remotest past must be quite different from those of the present time. However, as a statement of facts and an overall summary of the relationship between land and environmental and their interaction with man and his culture, the description of the present-day geography serves as a good beginning. It emphasizes the role played by the varied characteristics of the land, diverse array of available resources, and cultural and linguistic diversity of its people in shaping the history of this land as well as that of the India, Afghanistan and Central Asia. It also shows the way in which the roots of regional character extend back into the early Stone Age.

The following paragraphs briefly touch upon the current geography of Pakistan, especially those areas which are pertinent to the main topic of this book, namely, the Stone Age of Pakistan. Before we begin, however, a point of much importance must be made. Like Europe and other major cultural entities of the world such as India or China, Pakistan has an unmistakable character of its own. One of the underlying reasons for such definable cultural identities in all these major regions is that each has had a long history of internal cultural development which has formed deeply rooted patterns of thought, religious and philosophical attitudes, social behavior, artistic expression, and a range of diverse but interrelated life-styles.

Also, a note of precaution must be struck: notwithstanding the paramount importance of natural boundaries in defining a country, one should keep in mind that the terms 'boundaries' and 'borderlands' in archaeology and prehistory denote something wider and more fluid and it is in this context that the issue must be discussed and examined. For our purpose, we are dealing here with an area, which is generally known in archaeological literature by the name of the *Greater Indus Valley.* This area spans from the Ghaggar-Hakra river basin and the Indo-Gangetic Divide in the east to the far end of Baluchistan and the entire stretch of the Sulaiman Mountains, with their numerous passes. Its northern boundaries are in Kashmir and its southern borders are defined by the Arabian Sea, starting from the coastal Kutch to the farthest end of the Makran coast. These boundaries more or less describe the political boundaries of modern Pakistan also.

A Distinct Cultural Entity: A number of historical and cultural events suggest that in the ancient world there was a notion of a geographical entity between the Hindu Kush mountains and the Thar Desert. We hear the early Arab travelers talk about the *Country of Sind* (*Mumlikat-e-Sind*) as opposed to that of *Hind*. Even before this time, we read the Greek writings that describe the people of *Indos* different from those of the *Across the Desert*. Delving still deeper in the remote past, we have the hymns of the RgVeda praising the rivers and mountains of this country to the almost total exclusion of those beyond the Beas River. Of course, the Indus Civilization was a natural and obviously demonstrable manifestation of this geographical entity. It could not be just a fluke of history that a coherent material culture repeatedly originated and thrived precisely in an area which is now defined

by modern political boundaries of Pakistan.



Geographic location of Pakistan in relation to the rest of South Asia

As we proceed with the examination of the types of stone artifacts in the Stone Age, as we look at the pottery and its decoration in the Neolithic times, as we marvel at the city planning of the urban centers in the Bronze Age, as we sing the hymns of the RdVeda, and as we observe the rising of cultural, commercial, and educational centers in the post-Vedic period around Taxila, we cannot but conclude that this area has been culturally distinct from that which now goes by the name of India on one hand and Afghanistan on the other. This probably explains the description of the immensity of the world in Punjabi and Saraiki languages as *Hind te Sind*.

Defining Geographical Pakistan: For defining the geographical Pakistan, we first need to define its natural boundaries. Let us begin in the north. At first sight, the formidable mountain ranges of the north give Pakistan an aspect of exclusiveness, which it does not in fact possess. For example, there are a number of feasible, if arduous, routes that enter eastern Turkistan and Xinziang province of China from northern regions and Kashmir. The most notable of these routes uses the famous Khunjrab Pass through which the modern Karakoram Highway passes, connecting transIndus Kashmir with the high Asia. However, neither

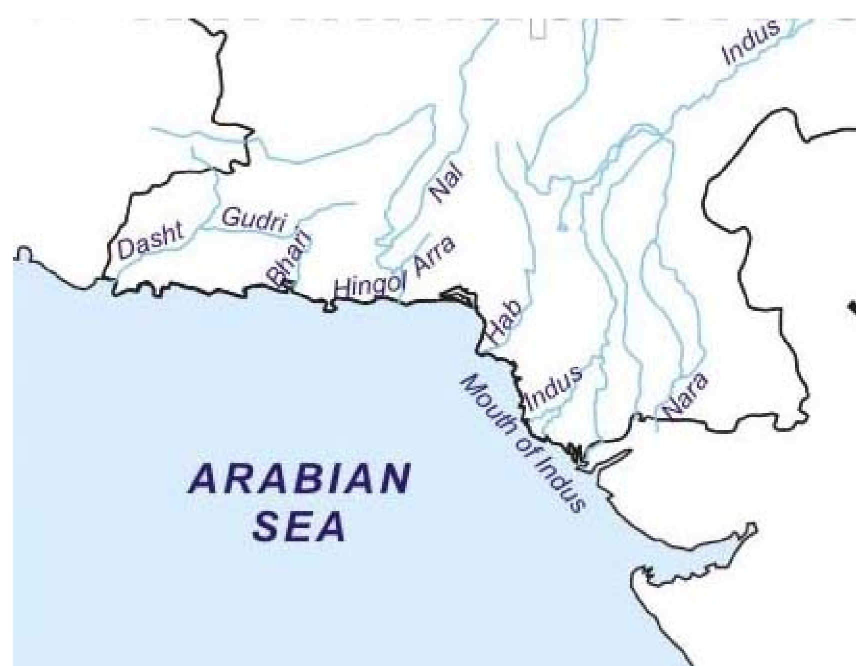

Baluchistan coastline at Gawadar

this nor any other of these northern approaches has played any dominant role in the formation of Pakistan's culture or materially affected its history. Their importance lay rather in the reverse direction: they were among the chosen channels for the diffusion of Buddhism and certain aspects of Buddhist art from Pakistan to Central Asia and China during the early centuries A.D. Some routes between Peshawar and Chitral lead to the Pamirs, the most famous of them going via Hunza and Gilgit. There were two major central Asian trading marts beyond the Pamirs – Kashgar and Yarkand – which were reachable through various passes. There were routes to Central Asia from the direction of Leh in Ladakh as well, skirting the foot of the high peak of Muztagh Ata.

Mention must be made here of the fact that all these routes across the Karakoram, and at least the main ones which went to northern Afghanistan, were feeders of the famous Silk Route which went all the way from China to Rome in the early years A.D. Another fact, which calls for attention is that the routes across the main Hindu Kush massif in central Afghanistan were closely linked with the routes moving into, or coming from, ancient Pakistan. It was along such routes that Buddhism spread to Central Asia and there are many Buddhist statues and painted caves standing sentinels along these hills and desert paths. The famous Buddha images of Bamiyan in the Hindu Kush (some of them destroyed by the Taliban Government in Afghanistan), the sensuous ivories of Bagram in the Kabul region, the caves of the Thousand Buddhas at Dun Huang at the edge of the Taklamakan desert
- these are only some of the beauteous things marking the trail of merchants, monks and pilgrims along these routes, linking Pakistan to the far reaches of Chinese Turkistan.

Looking to the South, there is a long coastal strip at the Arabian Sea, locating several seaports such as Gwadar in the West and Karachi in the east. Jewni, Ormara, Pasni, Sumiani, Dhab, and several other minor ports serve fishing villages along the coast. A look at the map suggests Pakistan's central role in any traffic in the Arabian Sea. The Indus delta has been traditionally linked with the Gulf, so have the other ports along the Makran coast. The coastal regions in the west enjoyed traditional mercantile

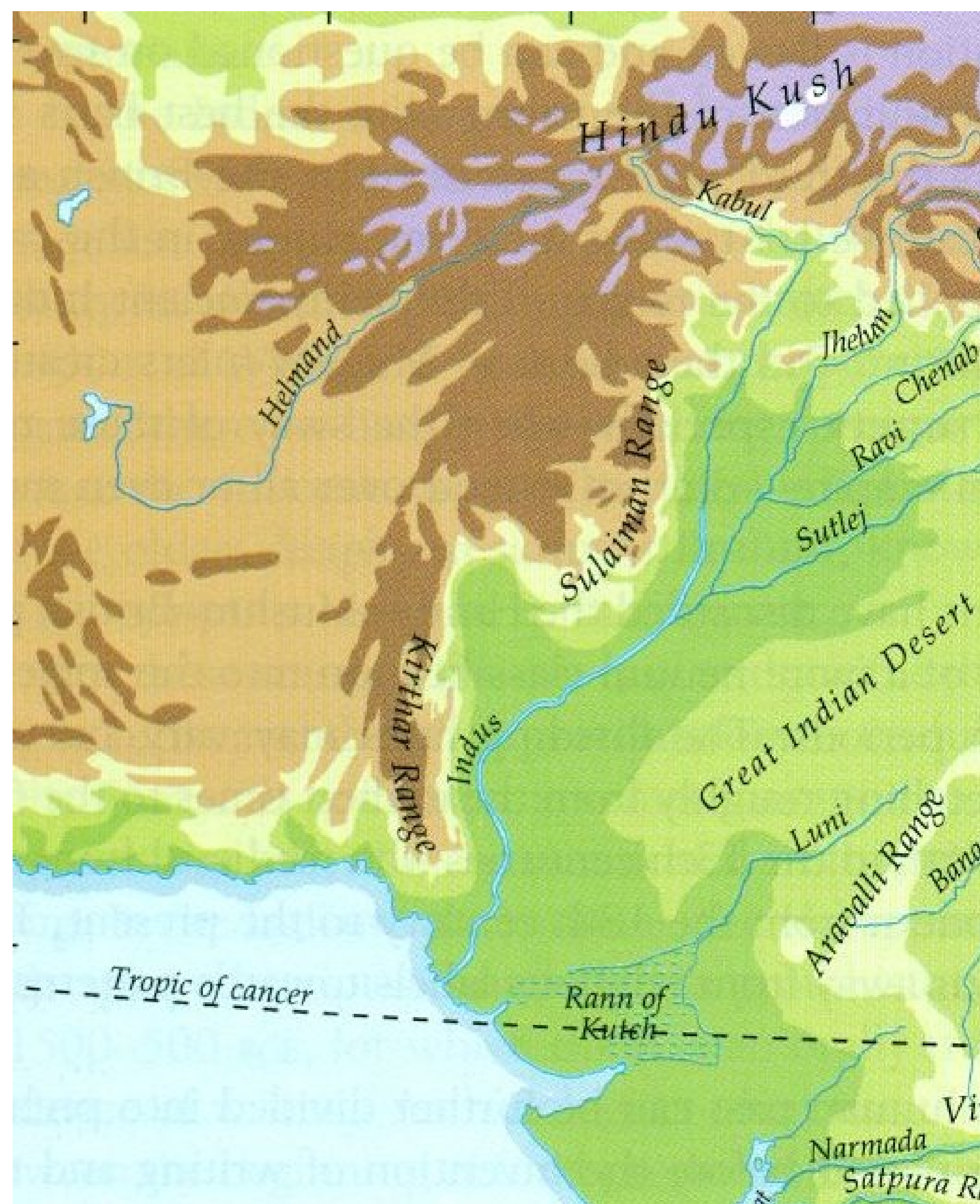
intimacy with the east coast of Africa, from where the Indus man learnt the cultivation of millets, especially *bajra* and *jawar*. These proved to be important crops for the summer months in the Early Indus period: these grains helped in producing the 'surplus' that was an essential element for the beginning of urbanization in the Indus valley in the 3rd millennium BC.



Coastal Makran and the Indus Delta

Start at Karachi on the Arabian Sea. Here is the narrow strip of land between sea and mountains, which is the southernmost gateway to Pakistan; a gateway that witnessed the passage of Alexander and his armies to Persia after what was probably the most ambitious military adventure in history. Here Mohammad Bin Qasim led the Arab and Persian armies in the eighth century on to the conquest of *Al-Sind*. Northward, the SulaimanKirthar Hills mark the easternmost extent of the plateau of Iran. These hills run parallel to the course of the Indus.

South of the Himalayas in the present-day India lay the Great Ganga-Yamuna plains with an average width from north to south of some 200 miles and an average height of 500 feet above the sea. The prehistory and much of the history of the



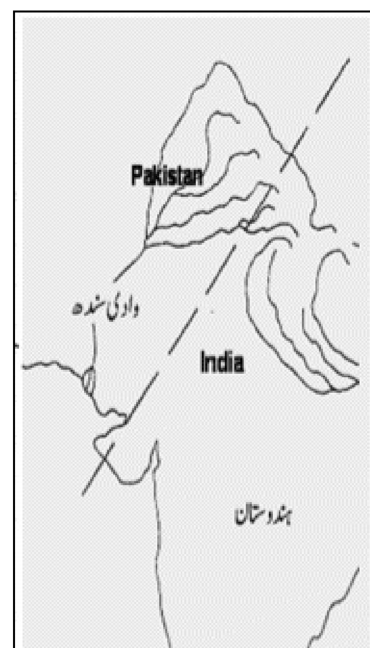
Kirthar Range and the Sulaiman Mountains in the West of

Indo-Gangetic divide, to Kathiawar in the south (see the map). It is therefore not surprising that the eastern boundaries of ancient Pakistan were along this line. What is surprising, however, is the fact that the political boundaries between Pakistan and modern India also run more or less along the same separation line. Thus, it seems as though Nature itself ordained the eastern boundaries of Pakistan as much as it did those in the West, the South, and the North.

Although Paki
stan, as a geographical
entity, was largely cut off
from the area that now
forms the Indian Union
for the presence of the
intervening desert, the
Thar, the marshlands in
the north-east, and in
the Indus Delta in the
southeast, some limited

contacts between
two regions was
the

defi
nitely possible. There
are some signs of the
contacts during the Pa
leolithic between north
India and northeastern
parts of Punjab through
a narrow corridor
along the foothills of
Himalayas and there

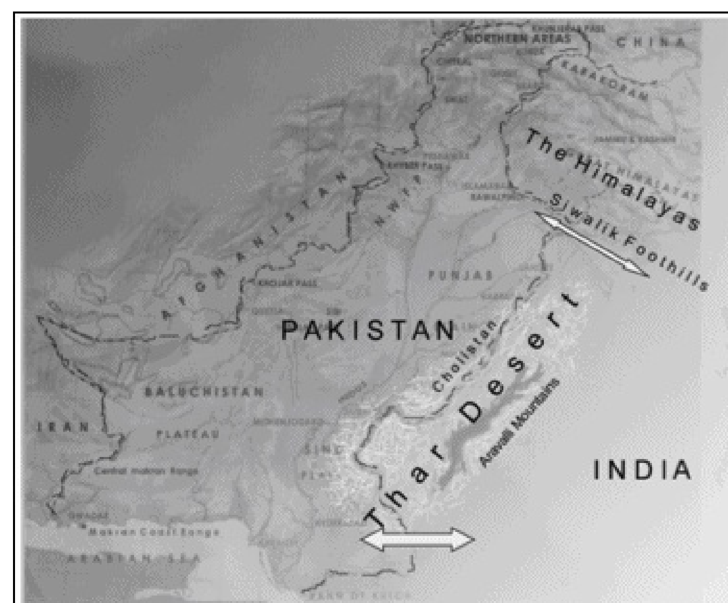


all

the are
the Indus plains
definite signs of some contact between Gujarat and

A geographic separation line between Pakistan and India (Ahsan's *Indus Saga*)

two plains, that is, the Indus plains on one hand and the Ganga-Yamuna plains on the other, in spite of their superficial continuity on the map, is strikingly different. Without going into details, it should suffice to note that the land of the middle and lower Indus is barred from the plains of the Ganga and Yamuna as well as the Peninsular India by a vast desert, the Thar, of which Cholistan desert in Pakistan is a part. At the eastern end of the Thar Desert is the mountain range of Aravalli, which runs northeast to southwest and separates Pakistan from Central India as well as from the Peninsula. These two geographic impediments, the Thar and the Aravalli, form a fuzzy line of separation between India and Pakistan and kept the populations of the two regions more or less apart from each other for much of the prehistoric times. This demarcation line runs from the west of Delhi in the north, that is,



Northern and southern corridors of contacts between the peoples of Pakistan and those of India. A wide stretch of the Thar Desert lies between the two all along the borders

southern Sindh along the coastline and below the southern edge of the Thar. These contacts expanded to a considerable extent after the first millennium A.D. as Pakistan started to serve as a 'middleman' between the great landmass of India and equally great landmass of central Asia and the West. The general affinity of the peoples remained with the west but the east started to play an equally important role in the cultural development of this land. These contacts made it also possible to spread the knowledge of agriculture and sedentary living in the adjoining lands in the East during the second millennium BC. The high point of this interaction was the expansion of the "Aryans" and the Aryanized Indus people into the Ganga-Yamuna Valley during the first millennium BC, initiating a series of agricultural settlements to be established throughout these plains.

Pakistan's western borderlands - the Iranian Plateau

Pakistan's western borders, i.e. between Baluchistan and Iran and between Baluchistan and southern Afghannistan, are also quite interesting. They are directly connected with the topography of the Iranian plateau of which Baluchistan is a part. Iranian plateau has played a significant part in the ancient history of Pakistan. It is a block of land that intervenes between the Fertile Crescent countries of the Tigris-Euphrates Rivers and the Indus Valley. The plateau is essentially a vast basin with broad mountain chains thrust up at its rim, isolating the interior from the surrounding regions such as central Asia and the great river valleys of the Indus in the east and the Tigris-Euphrates in the west. The interior of the plateau is made up of sub-basins and deserts with interior drainage. On the east the basins are squeezed between the Koh-i-Baba mountain ranges of central Afghanistan and the coastal ranges of Makran on the Arabian Sea. The Koh-iBaba merges in the Hindu Kush and the PamirKarakoram-Himalaya chain on the east, while to the north of central Iran, the Elburz Mountains intervene between the Great Salt Desert and the Caspian Sea, merging with Caucasus on the Northwest. The Zagros Mountains are a southern offshoot joining the Caucasus to the coastal range of the Persian Gulf and the Arabian Sea. Only on the Northwest, where the hills are lower and phase down into the spacious plains and deserts of Central Asia, is the plateau rim less well defined by geography.

Too far to the west to be affected directly by the rains of the monsoon and too far to the east to be

affected strongly by the Atlantic and Mediterranean, the plateau is largely an arid land. It will be shown that the plateau's rim somehow constituted the area where man first domesticated plants and animals, starting an agricultural revolution in the ancient world. Baluchistan is the eastern rim of the plateau and it actively took part in this important phase of human history.

Pakistani Baluchistan is a part of Iranian Baluchistan and there is no apparent hindrance to communication from across the border in this sector. However, large deserts and desolate areas intervene between Iran and Baluchistan and consequently there is not, and there has not been in the past, any significant direct links between these two countries. All cultural contacts or any technological exchange which could have been taking place materialized through southern Afghanistan. There are two major lines defined by the location of deserts in Iran and Baluchistan. The first is along the Kech valley beyond the Makran coastal range, and the second follows the alignment of the Chagai hills through the desert and eventually reaches Quetta. Thus, the natural boundaries between ancient Iran and ancient Pakistan were almost the same as they are political to day.

On the northwestern frontier of Pakistan the picture is very different than that on the IranPakistan borders and for that matter in the east on the India-Pakistan borders. Here the pastoral routes into or out of Pakistan are many and some of them are still frequented. These routes generally converge on the Khyber Pass, which has been a major traffic axis since the establishment of Peshawar, the ancient *Purushpur*, as a metropolis about 100 A.D. No doubt, the Khyber Pass must have played an important part in the communication between Pakistan and Central Asia in facilitating the movements of men and beasts in more ancient time. In fact, there is strong evidence for the movement of men from west to east at the beginning of the present interglacial period some 15,000 years ago and probably earlier, during the Middle Paleolithic some 40,000 years ago. There is plenty of literary evidence that supports the movement of men and cattle through this route some 2,000 BC. Of course, most of the invaders also used Khyber Pass to enter Pakistan in later part of history.

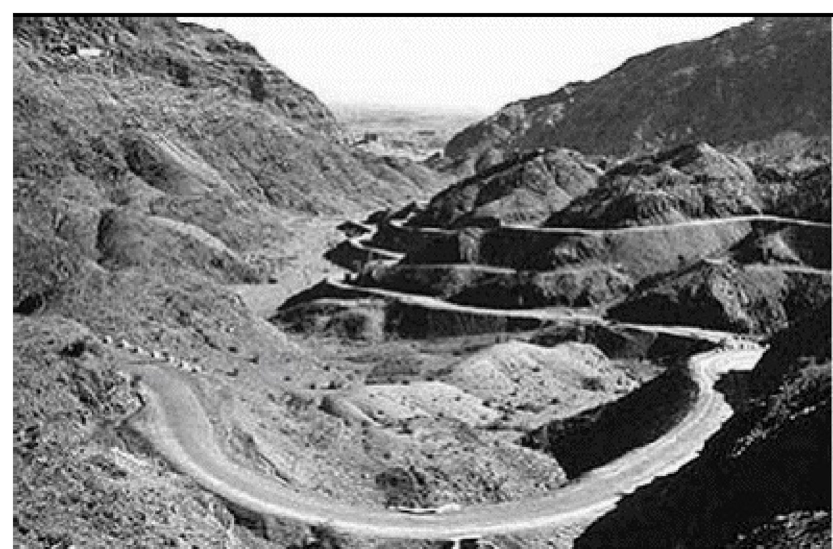
South of the Khyber are a number of alternative tracks which have been used and are still used; the most important being the Kurram valley and the Peiwar Pass. Still further south, the Tochi, Gumal and other valleys carry ancient thoroughfares from the direction of Ghazni and Kandhar uplands to the Derajaats and the Zhob valley. The Zhob valley carries or carried a modest traffic north to northeastwards from the direction of Quetta, itself the northernmost of the three focal points; others being Kalat and Las Bela. Southeastwards of Quetta a route enters the Indus plain via Sibbi. Westward from Quetta is a camel route that leads towards Kirman and southern and western Iran. At the southern end Las Bela, now an insignificant Baluch town, must have stood full in the tide of human immigration into Pakistan for centuries in the past.

We have then a geographical picture of a region mainly barred from the north and having restricted paproach to the east and the west but accessible in the northwest to the plodding traffic of Asia from the northern rim of the Iranian plateau and the Oxus valley. Commerce, migration and invasions have recurrently come in this way in historic times.This emphasis on the western borderlands as the source of population, new ideas, raw materials, and objects makes all the more important an awareness of the cultural sequences in such regions as Afghanistan, Iran, and western Central Asia. If the geographic premise is considered in its broader sense, then the cultural developments in those regions have a great bearing upon the cultures of adjacent Pakistan. Similarly, the technical and cultural developments in ancient Pakistan must have a direct influence on the adjoining areas in the west and the northwest, especially Afghanistan, Siestan, and western Turkistan. By the same token, we do not

see any importance of the area east of the borders except in very few situations where these borderlands were considered as a source of some particular raw materials. The lack of any significant openings between these two regions foreclosed any cultural contacts. aforementioned two openings and India were important for the diffusion of ideas, art, and objects from the west to the east. These openings, especially the northern one, also served as conduit for the west-to-east migration of people and animals in historic times. In this sense, northern part of Pakistan served as conduit between central Asia and India.

Despite this picture of interconnectedness, ancient Pakistan was never a part of Central Asia or Iran, even less so that of “India”. As much as Pakistan was isolated from the rest of the subcontinent, Nevertheless, the between Pakistan it was isolated from Iran. Its connection with the region to its northwest was better but still tenuous, consisting of a few narrow passes across an almost interminable mountain range. The passage to the north, across the Himalayas, was even more difficult. Thus, Pakistan emerged as a geographic and cultural entity by itself, the borders of which were marked out no less by nature than by man.

The Frontiers and the Interaction Zones: The boundaries of modern nation states are not the products of geography alone: they are the results of various historical situations. Oftentimes, they constitute the cultural and genetic interaction zones. Thus, the term ‘frontier’ in archaeology denotes something much wider than any politically motivated line would denote. It reflects a shaded territory which may be somewhat ill-defined on the ground but is broadly indicative of a transitional zone between two major geographical and cultural areas. This tends to denote sections where the influences from both the flanking geographical areas have been historically operative. On a general level, the frontiers are basically interaction zones. Theoretically, such interaction zones – areas of geographical and cultural transition – are available all along the western, north-western, north-eastern and south-eastern political boundaries of Pakistan.


A present-day view of Khyber Pass, connecting the northern Indus plains to the Hindu Kush mountains

However, not all these zones have been historically significant to an equal extent. From the point of view of Pakistan’s prehistory, it is the north-western frontier which is most significant. It was here that these worlds met the world of “India” in its generic terms.

The north-western frontier as an interaction zone is fairly wide and covers the southern part of central Asia; the eastern rim of Iran which runs from Meshed in the north-east to Zabul and Zahidan

in the Iranian Siestan; Afghanistan; and Kashmir. Both politically and economically these areas constitute a single interaction zone. Politically, the entire area was unified many times in the past. In other periods it was politically fragmented, a process subject to both local and central and west Asiatic factors. Almost all invaders and immigrant groups belonged to this area.

The second element which binds Pakistan together with the West is economic interaction, a fact which is archaeologically and historically well documented. Even now, every winter there are large-scale movements of *Powindah* traders from Afghanistan to Pakistan. While coming they bring goods from Afghanistan, and on their return journey they carry goods from Pakistan. Such subtle movements of populations have all too often been ignored in the writing of history.



Ganga plains in the first and second millennium B.C.

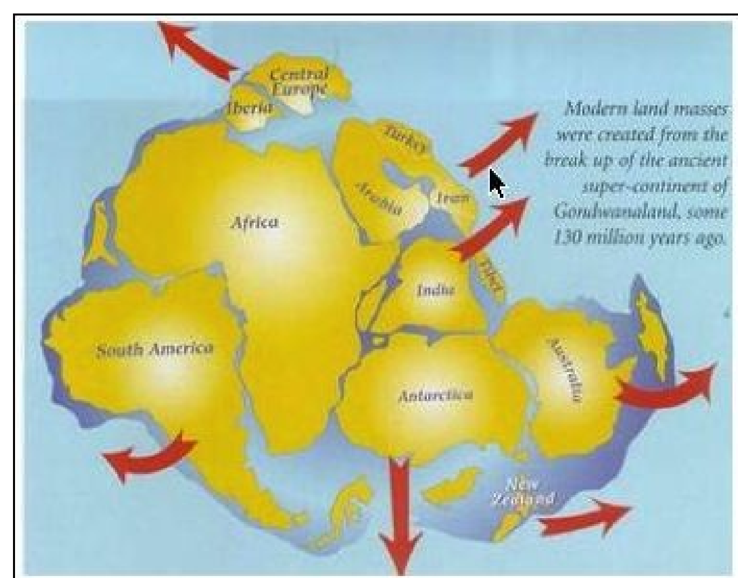
Geological Formation: Viewing Pakistan's topography as part of the continent of Asia (see the map below), it is not difficult to understand one of the underlying formative processes of physical geography that has important bearing upon its past and present character. This is the part played by the process known as *Plate Tectonics* in giving Pakistan, in fact the whole subcontinent, its shape. Briefly, Plate Tectonics concern the movement of blocks or plates of the earth's crust, which form the major land areas, or continents of the world. Over many millions of years, due to complex processes within the earth's core, these plates have been divided and been driven apart, and subsequently the parts have become attached to one another in different ways, forming new patterns and new major blocks or continents.

Many millions of years ago, the peninsular India and much of Pakistan were part of an older landmass, or plate, known as *Gondwanaland*, which included, among other major blocks, what are now the continent of Australia and the island of Sri Lanka and Mauritius (see the descriptive map above). When this block broke up, the Indian Plate became a separate entity, or large island, which drifted

Geological map of south Asia, showing the formation of Himalayan, the Pamir, the Karakoram, and Tan-Shien mountains. Pakistan is visible as and S-shaped 'wet' area in the middle of a vast desert

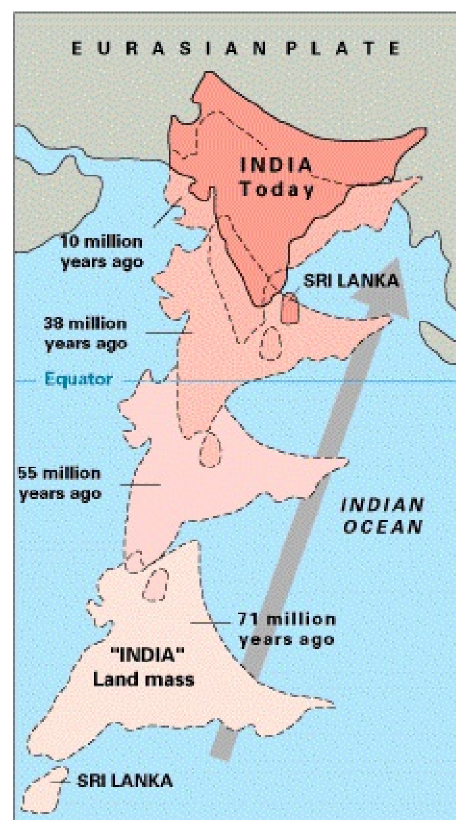
The second important interaction zone is along the borders of Pakistan with India and to understand the geopolitical factors in operation it is important to know the nature of a dividing line which one draws joining the west of Delhi, the Aravalli hills and the Gulf of Cambay. As explained in the above, this line, running through the middle of the Thar Desert, geographically separates Pakistan from the bulk of India. In one sense this marks a natural barrier to the cultural, technological, and even genetic

interaction between the Indus Valley and the bulk of India, and in another sense, like a funnel, this carries the thrust of the western cultures to the Ganga-Yamuna plains. This is the area where the influences emanating from the western parts of the Ganga-Yamuna plains and the Indus Valley have been operative through a narrow corridor along the Siwalik hills. A similar situation existed in the South where across the wasteland of Kutch and along the coastline of Sindh a robust interaction zone came into being. Genetic composition of today's populations in these borderline areas goes to prove this point, so does the diffusion of agriculture from the Indus Valley to the



A theoretical map of the super continent, the hypothetical landmass of the Gondwanaland

northward. Some twenty million years ago it made contact with the main Asian Plate, and with time the convergence became more forceful, the Indian plate pushing against and going under the Asian one and forcing up the Himalayas and Tibetan plateau in the north and the Sulaiman-Kirthar mountain ranges in the west in the course of a series of massive upheavals interspersed by quieter phases. The periods of uplift are considered to have had widespread effects upon surrounding regions as far away as



proof of continental drift and seafloor spreading. Earthquakes as well as the formation of continents and oceans are results of the same forces. Some plates form ocean floors while others become continents, both kinds of plates being made by trenches, rifts, and great fractures.

When the Indian plate separated from the *Gondwanaland* and drifted towards Asia, the latter was a smaller continent than it is today for the reason that Iran, Afghanistan, Pakistan, southern Tibet, and portions of Indochina and China formed part of the fringes of the ancient Indian subcontinent. The growth of Asia took place within the past 200 million years, and the continent's numerous mountain ranges testify to its geological history of gradual accretion of small continental fragments captured from *Gondwanaland*.

The ongoing process of convergence accounts for much of the physical structure of northern and western parts of Pakistan, as well as those of northern India. The height of the Tibetan Plateau and intermontane basins of Baluchistan, eastern Iran and southwestern Afghanistan, and the height, youthful steepness and jagged outlines of the mountain ranges are its direct outcome.

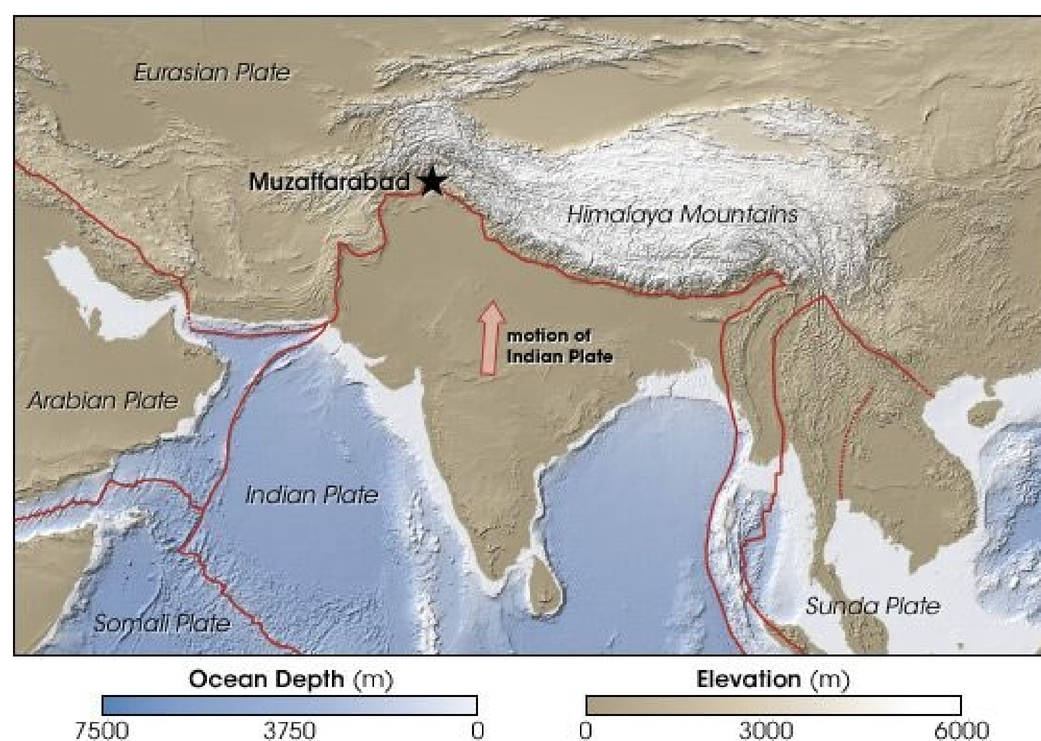
Secondary effects of the collision are witnessed in the extensive erosion of soil over wide areas by seasonal torrents, and the rapid downcutting and lateral movement of streams seen in the foothill valleys of the piedmont zone between the major mountain ranges and the plains, as for in

Drift of the Indian Plate to meet with the Asian Plate after de taching from the *Gondwanaland*, forming the Indian sub-continent

Japan and the Philippines. The latest is thought to have oc curred *ca.* 2.4 million years ago

and is still continuing. Often, the earthquakes like the one in 2010 in Kashmir is the result.

At present we know of 13 tectonic plates (2), massive brittle rock formations that may be 60 km thick under mountain ranges and 8 km thick under oceans. The earth's mantle is 2,900 km thick, and upon it rides the continental blocks like



icebergs shifting by internal convection currents of the under lying mantle. The continents may split if convection rises beneath them, or different fragments may be joined as continents colloid over seduction zones. The zonal distribution of seismic belts is one

2010 when Earth moved Azad Kashmir. Muzaffarabad sits at the boundary between the slowly colliding Indian and Eurasian tectonic plates, both composed of thick continental crust. The pressure of the collision isn't released gradually, but suddenly, when rocks that can no longer bear the stress crack. The fault line also

runs along the Sulaiman and Kirthar mountain ranges. These forces make Kashmir and western Pakistan one of the most earthquake-prone regions on Earth. The earthquake of Quetta in 1935 is a testimony of that. (NASA map by Robert Simmon**)**

stance in and around the Bannu Basin in southern Pakhtunkhwa (formerly, NWFP). Other examples are the much-dissected silts and rapidly changing 'bad land' topography through which the main Islamabad-Peshawar road and railway pass southeast of Attock in the northern Punjab, and again in the Pabbi Hills near Jhelum. Similar conditions prevail in other piedmont regions like the northern parts of Las Bela district. These processes, the upthrust of the mountains, the accelerated rate of erosion, and the massive deposition of eroded material in the plains, have been going on very actively during the entire time period of the Stone Age, and continue till today. The large-scale erosion in regions affected by the intercontinental collision is essentially a natural process, but clearly it is being accelerated by over-grazing, woodcutting, road building and other human activities.

The richness and productivity of the soils of the plains of Pakistan, which are constantly refreshed by silts carried out of the mountains by rivers and streams, is a further result of the collision process, and it has had immeasurable effects, directly and indirectly, upon cultural development in the Indus Valley. In the longer term, but still well within the timeframe of this book, the increasing height of the Himalayan and Karakoram mountain ranges has been shown to have had far-reaching effects upon the climate and on the environment generally. Most important of these are the conditions thus created to bring rainfall to the subcontinent in the form of the southwest and northeast monsoons. It is evident that the world we live in is constantly being altered by a series of dynamic processes on a scale quite beyond human control. Today, in addition to all the natural changes taking place, environmental change is being increasingly brought about by the activities of mankind.

Geographical Features of the Land: Geographically, Pakistan can be divided into five principal divisions of archaeological significance: (1) the Baluchistan plateau with the western highlands, Sindh Kohistan, the ranges; (2) the lower Indus Valley, represented by the Thar Desert, its western fringes, and the delta area; (3) upper Indus plains, traversed by the Sutlej, the Ravi, the Chenab, the Jhelum, and the Indus itself; 4) the Siwaliks, the Pothwar Plateau, the Peshawar Basin, and the Salt Range; and (5) the socalled ‘northern areas’ in the shadows of the Pamirs, the Karakorams, and the Himalayas mountains. Of these, the Pothwar Plateau, the Lower Indus Valley, and the Peshawar Plains are particularly important in the study of the Stone Age of Pakistan as these are the areas which have furnished us with the most relevant archaeological evidence. Other areas were either not populated by early humans or these regions have simply not yet been explored.

The Baluchistan Plateau and the Associated Area: The Baluchistan Plateau and the western highlands is truly the largest area of Pakistan, desolate, dry, sparsely inhabited, and divided into selfcontained valleys and internal drainage systems. The rugged and desolate character of these highlands is accentuated by the extreme sparseness of vegetation. In spite of the altitude, rainfall is scanty. Nevertheless, at places some water is available all the year round which affords adequate grazing to sheep and goats and to the wild ibex to support some isolated population knots. A noteworthy feature of these hill ranges is the development of gravel slopes at the base of the hills, forming a piedmont zone between the highlands and the plains. Whenever it rains - which is not often – the torrents fan out on vast areas of the plains downhills. This provides moisture for vegetation to grow and provide some subsistence for domestic animals. Some of these locations may provide enough

represented by Kirthar, and the  Sulaiman
Gorakh Hill area in the Kirthar Range

moisture for date palms to grow and make some rudimentary agriculture possible. It is at these locations where earliest settlements of mankind arose in South Asia. One such site of archaeologically immense importance is Mehrgarh on the border of Baluchistasn and Sindh.

The plain immediately adjoining the slopes in the northern sector of the Baluchistan plateau across the lower reaches of the Bolan River is known as Kachi. This track of land is at the foot of the Bolan Pass, which splits the Sulaimans at the heart of the chain. At the northern head of the Bolan Pass is Quetta. Here the mountains swing north



35 sq.m. as a result of post-monsoon drying. This periodically changing level of water thus affords an excellent arable land for cultivation, especially for the *rabi* crop. In the proximity of the Manchar Lake, we find a series of hot water springs, which also afford opportunities for food production and animal grazing. Similar ecologies exist throughout Baluchistan, albeit in smaller scales, and wherever such a combination of water and arable land existed, small pockets of population arose which collectively gave birth to several regional cultures in the post-Pleistocene period.

The Lower Indus Valley: A large part of Pakistan is a desert or near desert which, in terms of global geography, forms an extension of the Persian desert. This includes the semidesert highlands of Baluchistan and parts of the Pashtun country. Whatever rainfall there is

Hub Valley, a gateway to Al-Sind

and east in concentric loops crowned by fairly high peaks. Northward, the Sulaimans form the homeland of the Pashtuns. The aforementioned northern passes of the Gomal, the Tochi, and the hKyber are in Pashtun country. Mehrgarh, mentioned above, lies at the western edge of this plain.

An equally distinct tract, known as the plain of Las, the Las Bela, extends about 90 km northwards from the seacoast. It drains an area of considerable magnitude in Kohistan and is composed of alluvium deposited by the Porali, Hab, and Malir Rivers. Yet another potential agricultural area lay about Lake Manchar. This largest freshwater lake in Pakistan, in fact in the whole of the subcontinent, was the repository of water spilling from the flood channels of



the Indus. During periods of inundation, it covers an area of over 500 square km but shrinks to a mere



The Dry zone of eastern Sindh

A camel train in the Thar Desert

comes mainly in the form of winter storms. The Kirthar range separates the plateau of Baluchistan from the plains of Sind. These dry plains extend all the way to the Aravalli hills in India across the Thar Desert. The Cholistan Desert in the north of Sind and the southeastern Punjab is a part of the great Desert, the Thar. The conditions here are consistently more arid than elsewhere in the country.

The borderline areas of the Great Dersrt, i.e., the fringes of the Thar Desert, are important in archaeological context: Bridget Allchin calls these areas the *Dry Zone* (2). This includes most of the lower Indus Valley which practically coincides with the province of Sind and the adjoining plains of Lasbela. *Thar* means a dry place or wilderness, and, although it is not quite so profoundly arid as the Sahara or the Arabian Desert, it does form a formidable obstacle for men and animals to travel its length and breadth. It is a low rocky plateau or an undulating plain from which rise widely spaced groups of low-lying dry rocky hills. Between them, in places, there are dune fields consisting of rows of sand dunes sometimes a hundred feet or more in height, running approximately at right angles to the prevailing southwesterly wind. Formed by the wind, before which they are very slowly advancing in a northeasterly direction, they look like giant waves on the sea. Elsewhere there are great stretches of sand interrupted here and there by small rocky hillocks and by shallow valleys in which streams flowed in the past at times when the climate was somewhat less arid than today. The 'dead' drainage systems of the Thar are of great interest to archaeologists, as they give a clear indication that it was not always as arid as it is today. This and other evidence, both archaeological and geomorphological, show that at times in the past, the Thar has been a more hospitable region both for grazing animals and for people.

Despite the aridity of the region, life in the plains of Sindh and Leasable, namely the western fringes of the Thar Desert, is not as desolate as it sounds, thanks to a major perennial river, the mighty Indus, and several smaller and seasonal water streams to its west. Today, the Indus irrigates a vast area of the dry land of Sind. It also supplied the life-giving water to humans and their ancestors who inhabited this area in the remote past. Because of this extremely favorable situation, we find a large number of archaeological sites all along the Great River and around the various lakes which may have presumably been fed by the river water through regular inundations. This so-called ‘Dry Zone’ is extremely important in the study of the Stone Age of Pakistan and we shall visit it again in Chapter I.6 .

The Siwaliks, the Pothwar Plateau, the Soan Valley, and the Salt Range: Between the drifting Indian Plate of the Gondwanaland and the rising Himalayas, a basin was formed whereupon later Siwaliks were deposited. The name Siwalik is derived from the Siwalik hills at the foot of the Himalayas where a series of deposits of late Cenozoic Era are (see Chapter I.5) preserved and form an extension into Pothwar. Geologists divide the Siwaliks into Lower, Middle, and Upper Siwaliks. The lowest Siwaliks are represented by Chinji, Nagri, and Dhok Pathan Formations, all named after type locations in the Pothwar plateau. In the last 0.5-2.0 million years, these fluvial deposits have been tilted and uplifted through repeated and intense tectonic regimes, and are exposed as a range of low, deeply dissected hills. These sediments are divided stratigraphically into the Lower, Middle, and Upper subgroups, which are further divided into individual Formations that are all laterally and vertically exposed today in varying linear and random patterns. Paleoarchaeologists are primarily concerned with the younger sediments, the *Upper Siwaliks*, of whose ages are concurrent with Pleistocene hominin dispersal and occupation throughout West Asia, South Asia, and Southeast Asia.

The Sivalik Hills are the southernmost and geologically youngest east-west mountain chain of the Himalayan system. These hills crest at 900 to 1,200 meters and have many sub-ranges. They extend 1,600 km from the northern Punjab and Kashmir eastward through Nepal extending as far as Assam. There are vast networks of small hills and channels to form water streams which are ephemeral (transient) in nature. The Siwalik Hills are chiefly composed of mudstones, sandstones and coarsely imbedded conglomerates, and conglomerate formations which are derived from the Himalayas to the

north during Middle Miocene to Middle Pleistocene times. They are bound on the south by a fault system called the Main Frontal Thrust, with steeper slopes on that side. Siwalik Hills are located wihin the political boundaries of Pakistan, India, Nepal, and Bhutan, and range between 6 and 90 km in width and span over 1500 km in length. All of this area is a topographic continuum as it derives its formation, one way or the other, from the same natural forces: deposition, tectonic uplift, and erosion.

Ongoing erosion and tectonic activity has greatly affected the topography of the Siwaliks. Their present-day morphology is comprised of hogback ridges, valleys of various orders, gullies, choes (seasonal streams), earth-pillars, rilled earth buttresses of Conglomerate Formations, talus cones, watergaps, and choe terraces. Associated badlands features include a lack of vegetation, steep slopes, high drainage density, and rapid erosion rates. Due to a high rate of ongoing erosion and neo-tectonic activity, Siwalik sediments have not yielded stratified palaeolithic material of such integrity as known from other regions in the Old World. All documented Siwalik sites occur in varying geological contexts, primarily in Pothwar and the adjoining areas in India. In Pakistan, most of the findings occur in association with Upper Siwalik sediments and on 'erosional terraces' of the Soan river valley. The latter is a part of the Pothwar Plateau and is central to the investigation of the presence of hominids in Pakistan.

Pothwar is an extension of the Siwalik Hills, in the north of Punjab. It is an elevated plain, a plateau, situated between the rivers Indus to its north and northwest, and Jhelum to its east and southeasat (see map). Its north is squeezed between the sub-Himalayan mountain ranges of MurreeAbbottabad with lesser Margala Hills with height of 1200 meters. Its south is bordered by the Salt Range with major heights of 1054 meters near Pai Khel and 1522 meters at Sakesar with gradual decrease towards East. A basin is formed between this Salt Range and to the Mountain ranges of the north. In it are outcrops of rocks of the Kala Chitta hills south of Attock. The entire plateau covers an area of about 400-500 sq.miles.

Two large rivers, the Jhelum in the southeast and the Indus to the northwest, bound the Pothwar plateau on three sides. There are other small rivers, admittedly less in water content but decidedly more important historically. Haro, Soan, and Kanshi meander through its hilly landscape. These rivers are fed by water streams, some of which are perennial. All these rivers and water streams are lifeline for this region, on the banks of these are situated several cities such as Attcock, Rawalpindi, and Jhelum. Several other large villages and towns also flourish in this area, using the syncline and flood-pain for agriculture. Most of the area is, however, without water except that which becomes available in the form of some meager rain in summer and still less in winter.

Today, Pothwar Plateau is an undulating, multi-colored, picturesque area, which is largely known through a small river, the Soan. The Soan is a tributary of the Indus river and has given its name to a paleolithic stone tool industry which is essentially a pebble-based industry and supposedly a distinct entity, having more in common with the other pebblebased paleolithic assemblages of central Asia, China, and southeast Asia than with the generally endemic biface lithic tradition of not merely peninsular India but also the rest of Pakistan.

The Siwaliks provide one of the longest, best calibrated, and most detailed fluvial sequences of their age in the world. Because they are also (for the most part) rich in fossils, the Siwaliks are also one of the best terrestrial faunal sequences in the world, particularly for the Miocene. The first fossils were

collected in the early nineteenth century, and the first monograph on Siwalik fossils was published by Falconer and Cautley as early as 1845. An immense amount of paleontological and stratigraphic researchhas been conducted by officers of the Geological Survey of India in the British period, especially between the two world wars, and this was supplemented by the Yale Expedition (1934-5), which resulted in the discovery of the Miocene hominoid *Ramapithecus punjabicus* and the Pleistocene Soan Flake Industry. Much paleontological research has also been conducted in Pakistan and India in the last twenty years.

The historical geology of the region has come into sharper focus during several seasons of research in the Siwalik and Pothwar region, beginning in 1980, by the British Archaeological Mission in Pakistan. It has been confirmed that the Himalayan ranges were folded and elevated for the past 20 million years by the impact of the continental block of India against the ancient Asian landmass. In the course of this movement, silts and gravels were transported by streams to rest in troughs bordering the mountains. The Siwalik hills were laid down as a series of horizontal strata between 4 and 0.7 million years ago. These strata became folded at varying rates in different localities in the Pothwar, a process that took place between 1.6 and 0.4 million years ago. Erosion caused the upward folds to be dissected and planed off, forming the badlands of tabletop projections on the landscape. Silts and gravels from the high ranges continued to move into these areas, filling up hollows and spreading over flat land. The Lei Conglomerate is the name for this deposit. Loess was deposited more recently over the area, attaining a depth of 15m in some localities.

Northern Areas: As far as the 'Northern Areas' are concerned, practically no archaeological work has been done in this region, beyond one German expedition that primarily explored the remains of the Gandhara culture and traced the footpaths of the Buddhist travelers in historic times.


A view of Pothwar Plateau near Kallar Kahar

From the point of view of the study of the Stone Age of Pakistan, this area is rather barren and of little interest to us. This is a rugged area, high mountain peaks, generally of extreme cold, and at places infested with glaciers. In the Ice Age, it would have certainly been an area of very low interest for the early man to inhabit. This general area, for some other reasons, is like the one in most of

Baluchistan, where neither any Paleolithic investigations have been undertaken nor any positive discoveries from the Stone Age are expected.

The Indus Plains: The Indus plains can be conveniently divided into two parts: the lower Indus plains which is a relatively narrow east-west strip about 200 km wide, contained by the Thar Desert on the east and the Kirthar Range on the west; and the upper Indus plains, practically comprising of Punjab and the Pashtun country. The Indus tributaries - the aKbul, the Swat, the Jhelum, the Chenab, the Ravi, and the Sutlej, and the Beas, dominate the area of the upper Indus Valley, which roughly coincides with the area covered by Punjab. Surprisingly large part of Punjab does not yield any Paleolithic, or even Chalcolithic or Bronze Age archaeological site. The implications of this absence are not yet clear.

The Lower Indus valley as we see it today is an extremely arid region totally dependent upon the Indus to sustain human life. As in the Thar, there are indications that it may not always have been quite so arid, and that areas along the northwestern margin of the plain in particular may have been able to support grazing animals and sustain dry cultivation in a way that is not possible today.


Rising sun over the Siwaliks

To the east of the Indus lies the dried-up drainage system of the Ghaggar-Hakra which used to join the Indus before falling combinely into the Rann of Kutch. it is now a small stream that loses itself in the Punjab plain, its former course marked by abandoned settlement sites of Harappan times. Their distribution indicates that its flow was reduced, causing it to dwindle and retreat back towards the Himalayas in a series of stages. It seems that the flow of the Ghaggar-Hakra may have been captured by another system, probably that of the Jamuna during later prehistoric or Early Historic times.

Human Settlement in relation to the Geography of Pakistan: The geographical factors relevant to the human settlements in the Indus Valley are similar to those between the Mesopotamian lowlands and the Iranian highlands. However, if we go deep into the ancient past, we first detect the presence of the early humans and their ancestors in the plateau of Pothwar, not the riverine plains of the Indus. The alluvial plains of the Indus came under habitation rather late in time, somewhere in the middle or late Pleistocene. This is an important research topic and a crucial one to the prehistory of Pakistan. We shall, therefore, follow it in several places in the course of this book.

The Rivers: The Indus and its tributaries have played an important role in the economic life of Pakistan throughout its history. In its lower reaches, typically in Sindh, the Indus tend to build up its bed with material it has not the strength to carry, and is subject to seasonal or flash flooding and

frequent lateral movement of its channels. In the regions of Punjab, Pothwar, and the Pashtun country, the rivers – all of them the tributaries of the Indus – are more stable, flowing in firmly incised channels. Some of them even tend throughout the major part of their courses to cut down rather than build up their beds. To our interest, the river Soan in the Pothwar Plateau is one such example. Apart from this difference, the story of Pakistan's geography is essentially the story of the Indus.

The Indus rises in southwestern Tibet, and flows between two ranges of the inner Himalayas, in a northwesterly direction until it meets the Gilgit River flowing in the opposite direction down from the Pamirs. There the Indus turns south-westward, and makes its way through the high mountains. In the first half of its course through the Himalayan and Karakoram ranges, it retains the character of a gorge-enclosed river till Kalabagh below Attock at the border of Pakhtunkhwa and Punjab. Near the point where it enters the plains it is joined by the Kabul River, flowing out of the Afghan mountains to the north, fed by winter rains and melting snow. In the Punjab, it receives the water of four major tributaries, the Jhelum, Chenab, Ravi and Sutlej, all of which rise in the outer Himalayas and are snow and rain fed like the Indus. The Jhelum flows through Kashmir before coming down to Punjab. The Jhelum and the Chenab unite and their combined flow meets the Ravi. The Beas flows into the Sutlej within the Indian borders, the combine water then joins the Indus within the Pakistan‘s borders. The contribution of the Beas-Sutleg to the agricultural economy is, however, marginal in the present times due to the siphoning of much of its water through dams and canal irrigation upstream within India.


The birth of the River Indus in the highland of Tibet



Major rivers of Pakistan

The Indus also continues to receive water from a series of minor rivers, such as the Kuram, flowing from the northwestern mountains, and fed primarily by winter rains. Similar rivers continue to emerge from the mountains on the final part of its course through Sindh. Today, they tend, like the Bolan River, for example, to lose themselves in the silts of the plain before reaching the Indus but there is evidence that even five thousand years ago the Bolan, and probably other streams, carried sufficient water to flow directly into the Indus.

The upper courses of the Indus and its four major tributaries have been much affected by the uplift of the Himalayan and Karakoram mountains. Together they have a complex history of changing their courses and changing their confluences in the plains, which has continued into recent historical times. The plains of Sindh and the southern Punjab are covered with traces of abandoned river courses, some of which still serve as flood channels in times of spate.

The Indus in its lower course flows through an area of extreme aridity with a rainfall of 90 mm at Sukkur in upper Sind, rising to 173-177 mm at Hyderabad in lower Sind. The monsoon in Sind is unreliable, and for years together the rainfall may be well below the average, which is maintained by occasional exceptionally heavy rains. The fertility of the plain, therefore, is due almost entirely to the water of the Indus and its western tributaries such as the Bolan and other rivers. Today the water is distributed by means of extensive canal irrigation systems, but in the past the Indus has watered its plains by inundation in a manner comparable to the Nile.

Silt deposition and flooding that make the plain so productive render the lower lndus a highly unstable river inclined to build up its channel and change its course frequently. There is ample

historical, geographical, and archaeological evidence to show that this has happened repeatedly during historic and prehistoric times, and it has been ably discussed in all its aspects by Lambrick (3,4) and others. Flying over the Indus in a small aircraft brings home the recent instability of the river dramatically and the floods of 2010 are a grim reminder of the events that occurred so frequently in the past. The present channel is shallow and frequently braided to form a bed many miles in width at some places, and the surface of the plain from the Kirthar Hills on the north-west to the edge of the sand dunes of the Thar desert on the south-east is covered with old channels and cut-off meanders, some of which clearly still serve as spillways, flood channels and distributaries of the main river. The Indus is known to have shifted its channel across the entire width of the plain at more than one point in its course through Sind during the last three thousand years and probably did the same in earlier times. A change in the course of the main channel would lead to changes in the areas of the plain subject to inundation, and such a shift would have locally disastrous effects on human settlement and agriculture.



reaches of the valley and thus to a steepening of the gradient of the river'.

From the point of view of the early arc haeoIogy and prehistoric geography of the Iower Indus valley the precise rate of sedimentation is not so important as the fact that it has been on a scale sufficient to have brought about some change in the landscape since Harappan times. This appears to be the continuation of a process that had been going on for some time before the foundation of Mohenjo-daro, probably throughout the Holocene, indicating that the environment which the valley offered to early settled agriculturalists, and before them to the Stone Age hunting communities, dif

The River Indus near Sukhar

Continuous deposition of silt by the Indus and its tributaries has resulted in the steady building up of the plain as a whole. How rapid or how regular the process of sedimentation has been is a matter of discussion. The authors of the UNESCO report on the preservation of Mohenjo Daro *(1964)* estimate that the bed of the Indus and the level of the plain itself have risen between four and five meters since Harappan times *(ca.* 2300-1750 B.C.*)*, that is to say roughly five meters in five thousand years. Lambrick (4), considering the whole question in relation to the depth of occupation at Mohenjo Daro, and the antiquity of the lowest pre-Harappan levels there, argues in favor of a more rapid rate of accumulation, perhaps almost twice this. The same UNESCO report points out that at a depth of about eighteen meters a borehole in the locality shows a change from fine silt and sands to coarser sands which extend down a further forty-five meters. This, together with complementary evidence from other boreholes on the plain, probably indicates a major change in the regime of the river related to important changes in past climates or possibly to 'movements in the earth's crust leading to an upheaval of the headwaters and downwarping of the Iower fered progressively in certain respects from that of the present. One of the important points of difference would be that more rocky outcrops would be exposed on the plain itself and more fan material along its western margins, all of which has since been submerged. With it, no doubt, prehistoric sites of many periods have also been submerged and much of the evidence of early settlement in the valley lost. In view of the unstable nature of the Indus, and the rapidity with which the plains have been built up during the Holocene, it is perhaps more surprising that any Harappan or other early urban sites have survived at all than that their number today is relatively small. One can only assume that many have disappeared in the course of time, swept away or submerged in alluvium, and that those remaining reasonably intact are on exceptionally well chosen locations.

Instability of major rivers of the kind we have described can have a catastrophic effect upon human life, destroying houses and whole towns and cities, and ruining agricultural land. In areas of very low rainfall such as Sindh and the south-western Punjab, life depends entirely upon rivers bringing water from regions far away. Settlements, whether villages, towns or cities, are located close to rivers and water streams on which they are totally dependent for agricultural purposes and perhaps even for domestic water supplies. Any change in the course of a major river can be devastating, whether it sweeps away a settlement or moves away from its bed, leaving the inhabitants and their fields without water. We shall see when we come to look at the development of the Indus civilization (Volume III), that it was very much a child of the Indus river system and its environment.

I.4. Pleistocene Environment and Climatic Changes



The close relationship of the environment of any region and its developing regional character from the Paleolithic period right through to modern times has been apparent for some time and this realization is increasingly coming in focus in recent years. A large amount of geological

and oceanographic data has accumulated around the world during the past century and a half. These data have given us a fairly good idea about the climatic changes that have periodically occurred on a global scale. The research in Pakistan has been limited but whatever work has been done, ties up with the picture developing elsewhere. In this chapter we shall briefly touch upon the climatic changes which ancient Pakistan and South Asia generally experienced in the pre-Holocene period, that is, before the end of the ice age and prior to the development of man's capability for producing his own food. More to the point, we shall attempt to outline the available evidence regarding the nature of climate and environment in the major regions of Pakistan in the very remote past when man's ancestors were in the process of becoming 'humans'.

Every region of the globe has seen some minor changes in climate during the past several millennia. For example, some years are drier than the others with accompanied changes in average temperatures. These cyclic fluctuations, sometimes of a few years duration and sometimes of longer periods, however, do not disturb the ecology of an area over a long period of time. Every geological indication points to the fact that the climate of Pakistan has been the same for the last 10,000 to 12,000 years as we experience it today, although there certainly have been noticeable short-term fluctuations in atmospheric temperature or painful variations in rainfall. The situation is, however, different if we dare to peek into the really ancient past, i.e. the *geological times* of the Stone Age. The climatic changes were rather severe and they were of much longer durations. It is in these times that modern man appeared on the scene and it is here when these long-term climatic change really taxed man's ability to adapt and change. It is obvious that these changes must have had a profound effect on the pace and direction of human evolution in Pakistan as well as around the world.

The environments in which prehistoric people lived were very different from ours. Some of the major changes that gave the subcontinent its present form took place millions of years ago, in some instances long before hominids appeared on the planet. All over the world, the Pleistocene era, which began about 1.6-1.8 million years ago, was marked by dramatic climatic changes. There were several

ice ages and interglacials, corresponding to alternating periods of cold and warmer climate. During the cold phases, when ice sheets covered onethird of the earth's landmass, sea levels fell dramatically. When the climate became warmer, the ice melted and sea levels rose. It is believed that the tropical and semi-tropical regions, such as Pakistan, went through alternating dry and wet phases (interpluvial and pluvial phases), but the rhythm of Pleistocene climatic changes in these parts of the world is not fully understood.

Pakistan is now a semi-arid, subtropical land with some winter rain falls and some summer monsoons. Rainfall patterns shape the distribution and abundance of flora and fauna, offer essential nourishment to stressed ecologies during dry seasons, and present vital water supplies for sustaining plants and animals. It also has bearing on the strength in water streams and rivers. The subcontinent has been a monsoonal environment since the Miocene, although fluctuations and shifts in its intensity are registered through time, in part due to the Himalayan-Tibetan uplift, discussed elsewhere in this chapter. Obviously, monsoonal shifts during the Pleistocene and marked seasonal changes in wet and dry periods must have structured hominin settlement behaviors and the survival of populations (5,6).

The Pleistocene environments of the subcontinent were influenced by larger global patterns of climate, but sometimes also by distant seismic events. For instance, about 75,000 years ago, a gigantic volcanic super-eruption occurred in Sumatra at a place today represented by lake Toba. This seems to have led to a complex series of palaeoenvironmental changes in late Pleistocene times, which had a Significant impact on hominid populations in the region. Tephra ash deposits arising from this eruption have been found embedded in river valleys in peninsular India, and the impact of the Toba eruption on hominid populations in this area is being studied.

About 10,000 years ago, the Pleistocene era made way for the Holocene era (which continues into our own time) and the basic climatic patterns that prevail in the world today were established. This does not mean that there have been no significant climatic changes in the last 10,000 years. It is just that these changes have not been as enor- mous as those that occurred within the Pleistocene. The beginning of the Holocene was initially marked by wetter climatic conditions than those of the late Pleistocene but it gave way to a decreasing humidity till it stabilized some 3,000-4000 years ago to a weather pattern of to-day.

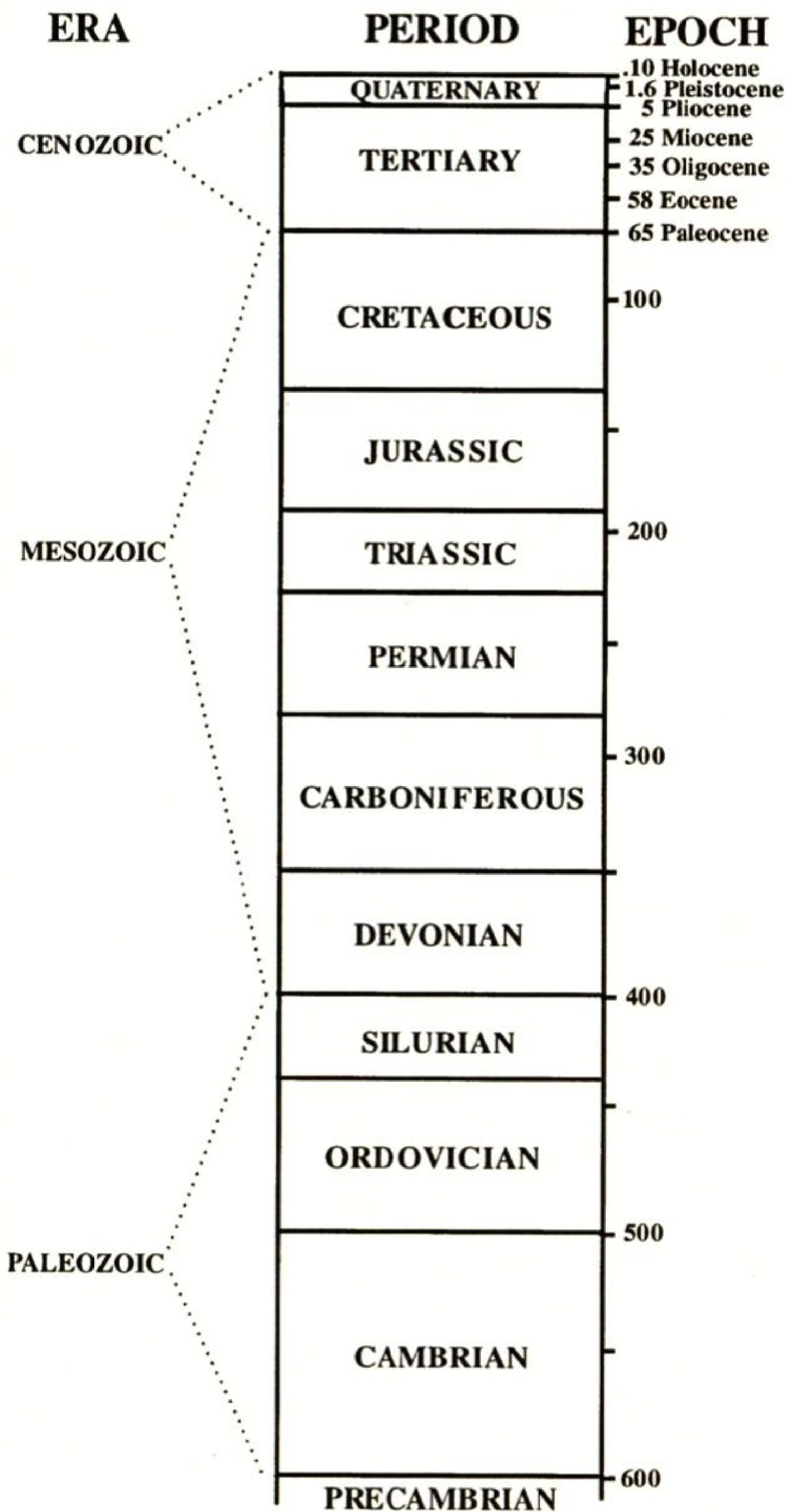
The Thar desert today has very little naturally occurring surface water, except for short periods in the rainy season, and people have to rely on rain water stored in tanks, wells, tube wells, and canals. A study of the western Rajasthan section of the Thar desert, especially around Didwana in Nagaur district, indicates that the present environment of the Thar is very different from what it was like in the Pleistocene era. Except for a phase in the upper Pleistocene (25,000-13,000 years ago), during most of that era, surface water in some quantity was always available; the flora and fauna was as a result much more abundant than it is today.

The study of the specific features of paleoenvironments is a very important part of prehistory. Detailed paleo-environmental studies are so far available for very few parts of Pakistan., even less for India. One of the earliest such studies was conducted in 1935 by de Terra and Paterson on the Soan river in the Potwar plateau, between the Pir Panjal and Salt ranges in Pakistan. Their team found a large number of tools, mostly of the middle and upper paleolithic, some of the lower paleolithic as well. De Terra and Paterson identified five toolbearing terraces (a terrace is an old bed of a river) of the Soan and tried to correlate these terraces with the theory of a four-fold glacial cycle in Kashmir,

and further, with a four-fold European glacial cycle. Although most of the correlations, sequences, and conclusions of the de Terra-Paterson study are no longer accepted, it marked an important stage in the history of prehistoric research in Pakistan. This is an important study and we shall come to it again a little later. There are some other studies, to which we shall make reference as we proceed, as well.

Geological Time Scale: The *geological time scale* is used by geologists and other scientists to describe the timing and relationships between events that have occurred during the history of Earth. The topographical formation of different continents, the evolution of genus *Homo*, the emergence of modern man, the dispersal of human populations over the face of Earth, and the technological progress experienced by humans in different geographical regions largely occurred during this geological timeframe.

The principles underlying geologic time scales were laid down by Nicholas Steno in the late 17th century. Steno argued that rock layers (or *strata*) are laid down in succession, and that each represents a "slice" of time. He also formulated the principle of superposition, which states that any given stratum is probably older than those above it


ERA
PERIOD
EPOCH
CENOZOIC
MESOZOIC
PALEOZOIC
QUATERNARY
TERTIARY
CRETACEOUS
JURASSIC
TRIASSIC
PERMIAN
CARBONIFEROUS
DEVONIAN
SILURIAN
ORDOVICIAN
CAMBRIAN
PRECAMBRIAN
.10 Holocene
1.6 Pleistocene
5 Pliocene
25 Miocene
35 Oligocene
58 Eocene
65 Paleocene
100
200
300
400
500
600

Geological time scale in terms of eras, epochs, and periods.

and younger than those below it. While Steno's principles were simple, applying them to real rocks proved complex. Over the course of the 18th century geologists realized that (i) sequences of strata were often eroded, distorted, tilted, or even inverted after deposition; (ii) strata laid down at the same time in different areas could have entirely different appearances; (iii) the strata of any given area represented only part of Earth's long history.

Eons, Eras, Periods, Epochs, and Stages: In the geological scheme of reckoning, the largest defined unit of time is the *super eon* composed of *Eons*. Eons are divided into *Eras*, which are in turn divided into *Periods*, *Epochs* and *Stages.* At the same time paleontologists define a system of faunal stages, of varying lengths, based on changes in the observed fossil assemblages. According to the geological nomenclature, we are presently passing through *Phanerozoic* Eon, *Cenozoic* era, *Quaternary* period and *Holocene* epoch (see the diagram above). The *Quaternary* period, together with the preceding *Tertiary*, spans over 50 million years while *Holocene* epoch is taken to have begun some12,000 years ago. Preceding the Holocene was the *Pleistocene,* which is thought to have be which is thought to have be 12,000 years ago.

From the point of view of human history, we are concerned only with Cenozoic era (time period between the present and about 100 million years ago), of which Neogene period is of more relevance. The Neogene Period is divided into four Epochs:

1) *Miocene*, starting at 23 million years ago and characterized by moderate climate. Modern mammal and bird families became recognizable in this epoch, horses, mastodons and first apes appear, and diverse grasses become ubiquitous.

2) *Pliocene,* starting at 5 million years ago and characterized by intensification of the Ice Age. Australopithecines, many of the existing genera of mammals, and recent mollusks appear. *Homo habilis* appeared in this epoch. During the Pliocene, continents continued to drift toward their present positions (see the last Chapter). Climates during the Pliocene became cooler and drier, similar to modern climates. Ice sheets grew on Antarctica during the Pliocene.

3) *Pleistocene*, starting at about 2 million years ago, is characterized by flourishing and then extinction of many large mammals (Pleistocene mega fauna). It is in this age that evolution of humans largely progressed. This evolutionary process ultimately culminated in the development of anatomically modern humans in the late Pleistocene.

4) *Holocene*, starting at about 12,000 years ago, it is characterized by the end of the last glacial period and the rise of human civilization.

In the interest of the material covered in this book, namely, the evidence pertaining to the Stone Age, we are primarily concerned with the Pleistocene, with some marginal interest in Pliocene and Holocene. The remaining of our discussion will, therefore, revolve around these three epochs, encompassing a time period of roughly 5 million years, spreading over varied timespans, as indicated in the table below.

Pleistocene and the Ice Age: Pleistocene is a technical term that denotes the last Ice Age during which glaciers repeatedly rolled across the northern hemisphere, bringing about tremendous

ecological and topographical changes. These glaciers periodically receded over long periods of time and recurred again. Northern parts of the earth experienced important geographic and climatic changes, which profoundly affected the evolution and spread of human populations across the globe. Since the end of the Pleistocene also corresponds with the end of the last Ice Age, the Pleistocene may be thought of as a series of ice ages, with glaciations lasting many thousands of years, separated by interglacial intervals of somewhat shorter duration. While it takes some 50,000 to 100,000 years to build up an ice age, it takes only 10,000-15,000 years to destroy it. The last Ice Age reached its maximum extension in Europe and North America some 20,000 years ago, and met its end some 10,000-12,000 year ago. This chronology may or may not apply to tropical or sub-tropical areas, such as Pakistan, but we can safely assume the general pattern to be in parallel: the absolute dates and durations may, of course, differ. No reliable geological work is available at this time for Pakistan or for any other region in South Asia which could be called forth to provide the chronology of the various glaciations and relatively warmer periods but it can be assumed that the glacial periods were here somewhat shorter and the interglacial periods somewhat longer than Europe. Also, the glaciation occurred, when it did, only in the northern parts of the subcontinent and did not extend down south to the extent they did in the Pliocene.

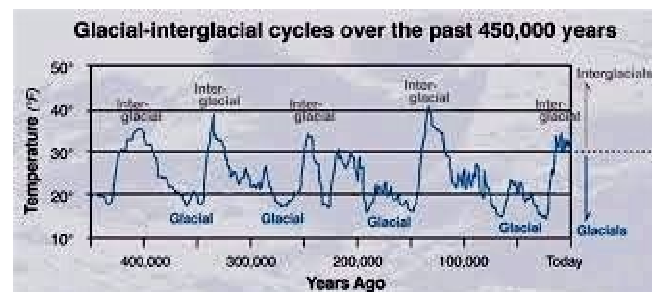
For much of the Old World, glaciation would have resulted in the expansion of desert conditions throughout North Africa, Arabia, Pakistan and western part of India, as well as an increase in savanna-type conditions and dry tropical forests in the tropical latitudes, in particular South Asia and Southeast Asia. The Red Sea would have remained connected to the Arabian Sea via the Bab al Mandab Straits; however, the Persian Gulf would have disappeared entirely, leaving a substantial expanse of sand dunes in its place (7). Coastal environments, such as expanses of sand dunes, mangroves, alluvial plains, coral reefs, and lagoon systems would also have been affected by increasing/ decreasing sedimentation, changing wind and rainfall patterns, and sea-level fall. Glaciation also implies that the monsoon system that normally provides seasonal moisture would have been suppressed across the Indian Ocean basin, resulting in greater aridity along much of the Indian Ocean rim. During the interglacial times, on the other hand, the reverse happened: sea level rose and drowned coastlines were common. During this time, deserts shrank and the atmosphere was somewhat moister.

During times of glacial maxima, ice covered one-third of the present land surface of the earth, and shorelines penetrated deeply into continental landmasses. When the waters locked in ice were released during a warmer interglacial episode, ocean levels were elevated to over 100 m, and ancient shore-lines disappeared. Unburdened with the weight of ice sheets, lands began to rise by as much as several hundred meters in local areas. As vegetation belts shifted by as much as 10° latitude during these fluctuations, rain forests expanded, deserts enlarged or retreated, inland bodies of water changed their volume and shorelines, and animals migrated.

There have been at least eight glaciations during the Middle Pleistocene (since 700,000 years ago), and since 1.6 million years ago there were at least seventeen major glacial cycles. The sequence of glacial-interglacial cycles based on terrace sequences on land have been proved incomplete and discontinuous. Oceanic and ice cores have shown that climate change in the tropics was also in tune with the temperate and sub-temparate regions, and was similar if not identical.

Deep Sea Cores and Oxygen Isotopes Stages: For a long time scientists believed that during the last ice age the four cold glacial periods, interspersed by three interglacial intervals, existed (see the table

above) and that these periods were simple advances and retreats of ice sheets. However, boring deep holes into the ocean beds to produce long cores of deposits showed a different picture. The deposits of the deep sea floor usually accumulate without interruption and therefore show a finer degree of resolution than is found on land. These deposits are made up of the detritus of dead sea creatures; of particular importance for studying the ice ages is the microscopic plankton, which has skeletons of calcium carbonate (coccoliths). If left for long enough in shallow tropical seas such de*Stages*. Within these regional cycles, OIS demarcate the boundaries between long-term trends of global warming or cooling. Stages 2 (24,000 – 13,000 years ago) and 4 (71,000 – 59,000 years ago) were the most recent full-glacials, while Stage 3 (59,000–24,000 years ago) was a temperate, variable period, generally called interstadial. Stage 5 is also a temperate, variable period, generally subdivided into five units of different intensities. Stage 4 is generally associated with the Middle and Late Pleistocene and hence with the dispersal time of 'modern' humans in South Asia and beyond in the Far East. In broad outline, the conditions of OIS 4 are thought to approximate (although to a somewhat lesser extent in terms of extremes in temperature and aridity) what is known for OIS 2 (the last glacial maximum, 24,000–13,000 years ago. The figure below depicts the various Oxygen Isotope Stages during the past 300,000 years. As may be seen from this illustration, the temperature fluctuations of the Pleistocene are extremely complex and that each major cold phase comprises a series of



Schematic representation of Earth's temperature during the past 500,000 year, showing the various glacial and deglacial periods

posits can build up to form chalk. Studies of the composition of these organisms which lived in surface sea water can tell us about the temperature present at given time by radiometrically dating the marine deposit trapped in the deposits.The study of coccoliths and the ratios of two isotopes of oxygen in their bodies quite accurately inform us about the sea temperature changes. Now, if a long, continuous core of these deposits from below the sea is dug out and studied section by section, a sequence of temperature fluctuations through time can be drawn. Such studies have been undertaken almost all over the world, including the coastal area of Sindh, and the ratios of oxygen isotope O^{18} and O^{16} over time have been plotted for various regions.

The O^{18} to O^{16} ratios vary cyclically and have been grouped into several *Oxygen Isotope* warmer and colder stages. It must also be understood that not each glaciation period was of the same intensity, nor was the inter-glaciation interval of the same warmth. Furthermore, the data shows that the frequency of change was considerably higher in the early Pleistocene than that in its later stages.

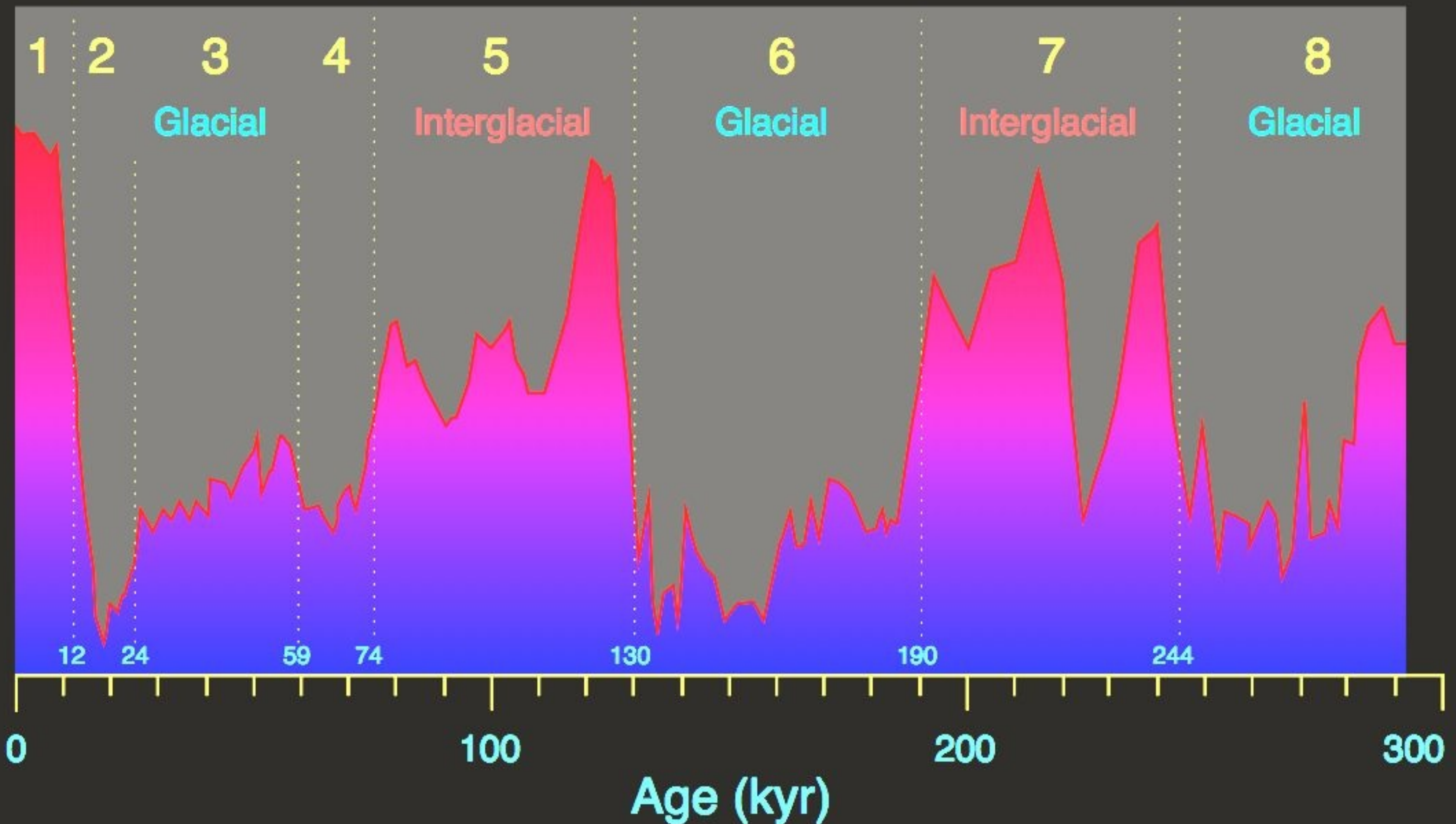
The oxygen isotope stratigraphy from deep sea cores has helped immensely in land-sea correlation and in revealing the pattern of glacial and interglacial climatic phase. The continental loesspaleosol stratigraphy, supported by the paleomagnetic time scale and radiocarbon dating, led to the revision of fourfold Alpine glacial sequence; as a result, other paleoclimate models based on this collapsed. Each glacial period had a different impact depending on how far south the ice extended, how long it lasted and consequently how much effect it had on the landscape and the plant and animal life located there.

Within each of the major glacials, smaller-scale warmer and colder periods occurred. On the basis of this analysis as many as eight glaciation periods have been confirmed by some researchers. Disagreement, nevertheless, continues over the question of the number of glaciations and interglacial periods and the fluctuations within these major events - the *stadials* and *interstadials* - that may have occurred during the Pleistocene.

Despite the progress made with deep core analyses, however, major gaps in mapping the course of glaciation and deglaciation exist. The correlation of glacial and interglacial events in different regions is a practice fraught with risk, given inadequacies of dating methods and inaccuracies in relating stratigraphical to faunal sequences. The record of ice sheet advances and retreats is also incomplete, although significant progress has recently been made on this account. The evidence from Pakistan and the borderlands have an additional problem: the periodic rising of the Himalayas under the forces of tectonic pressures, and the tilting and buckling of the already deposited strata. This situation has made the study of the deposited and eroded strata doubly difficult to interpret.

In recent years, ice cores from permanently frozen areas of the globe have also been studied for mapping the climatic changes in the atmosphere over several thousand years in the past and scientists have been able to deduce the changes in atmospheric temperature and the volume of ice, along with the related data such as entrapped oxygen, level of carbon dioxide, the dust level, etc. The determination of changes in the atmospheric temperature can be done because ice preferentially locks away the heavier oxygen isotope. can be deduced The data from the ocean cores generally correspond to those obtained from deep ice cores and the two techniques often complement each other, one furnishing one set of data and the other providing another but complementary set of data.The dating of the ice and sea cores can be compared to evidence for reversals in the earth‘s magnetic field, which are relatively well-dated and also show up in the marine deposits.

Global Context of Climatic Change: It was held for long that the cool and dry glacials of the temperate areas were accompanied by hot and wet climate in the tropics. It has been shown to be completely unfounded. It is now well established that, barring some regional influences of minor intensities, such as those mentioned above, the global climate operated as a single, interconnected system. For instance, the major deglacial intensification of the South-west monsoon over the subcontinent, marking the end of the Pleistocene, was synchronous with the major climatic transition recorded in the Greenland ice core. An earlier event at 16,000 years ago is also recorded in the Atlantic core. It should therefore be expected that all the regions of the world, with or without long-term proxy records, must have experienced synchronous climatic changes in the past, influencing human evolutionary and cultural processes. Quaternary climates in the unglaciated regions, such as southern Pakistan, also oscillated in accordance with the glaciated regions, even in terms of magnitude.



Visual representation of various Oxygen Isotope Stages during the past 300,000 years.

Considerable evidence has accumulated that points to the fact that vegetation changes in the tropics took place in response to glacial and interglacial cycles. The expansion of tropical savannas and the opening of tropical forests occurred during the Last Glacial Maximum. The equatorial Atlantic cores show an increase in diatoms at regular intervals derived from continental lakes, indicating low lake levels during periods of aridity. These periods were identified with those at 115,000-110,000; 95,000-84,000; 68,000-60,000; and 23,000-15,000 years ago which are arid phases of the last glacial cycle. Without a multidisciplinary program of research, reconstruction of Quaternary climates and paleoenvironments is a difficult task, and correlation of cultural stratigraphy to the glacial and inter-glacial chronology based on imprecise indices is problematic (8).

Three points are important to note in context with the geomorphological and climatic changes in the Pleistocene and their effects on the development of humans: first, there is no geological information from vast areas of the world; sec

Marine Isotope (MIS) or Oxygen Isotope Stages (OIS)

Marine isotope stages (MIS), marine oxygenisotope stages, or oxygen isotope stages (OIS), are alternating warm and cool periods in the Earth's paleoclimate, deduced from oxygen isotope data reflecting changes in temperature derived from data from deep sea core samples. The data is derived from pollen and plankton remains in drilled marine sediment cores.

The MIS timescale was developed from the pioneering work of Cesare Emiliani in the 1950s, and is now widely used in archaeology and other fields to express dating in the Quaternary period (the last 2.6 million years), as well as providing the fullest and best data for the study of the early climate of the earth. Emiliani's work in turn depended on Harold Urey's prediction in a paper of 1947 that the ratio between Oxygen-18 and Oxygen-16 isotopes in calcite, the main chemical component of the shells and other hard parts of a wide range of marine organisms, should vary depending on the prevailing water temperature in which the calcite was formed.

Working backwards from the present, MIS 1 in the scale, stages with even numbers have high levels of oxygen-18 and represent cold glacial periods, while the odd-numbered stages are troughs in the oxygen-18 figures, representing warm interglacial intervals. Over 100 stages have been identified, going back some 6 million years. Some stages, in particular MIS 5, are divided into sub-stages, such as "MIS 5a", with 5 a, c, and e being warm and b and d cold. A numeric system for referring to "horizons" (events rather than periods) may also be used, with for example MIS 5.5 representing the peak point of MIS 5e, and 5.51, 5.52 etc. representing the peaks and troughs of the record at a still more detailed level. For more recent periods, increasingly precise resolution of timing continues to be developed.

The following figures for approximate dates, taken from the list on Lorraine Lisiecki's website, are given for the past several thousand years.

MIS 1: ! 14,000 years ago - Present! Warmer MIS 2: ! 25,000-14,000 years ago! ! Colder MIS 3: ! 55,000-25,000 years ago! ! Warmer MIS 4: ! 70,000-55,000 years ago! ! Colder MIS 5: ! 120,000-70,000 years ago!! Warmer MIS 6: ! 191,000-120,000 years ago! Colder MIS 7: ! 243,000-190,000 years ago! Warmer

ond, there must have been regional differences in climate changes in the Pleistocene and their effects on the development of humans: and third, one is unsure of the extent to which the Pleistocene environmental situation differed from the current situation in terms of fauna and vegetation. The last point is important because of its bearing on human life. For the present, one is perhaps entitled to suppose that, although the Pleistocene landscape was no doubt somewhat different from that of the modern times, it might not yet be logical to conclude that the humans were then operating in a landscape with the resources of which the modern inhabitants of the land are completely unfamiliar. Eventually, terms like 'arid', 'semi-arid', 'wet', etc. do not have much meaning unless they are translated in terms of the extent of their variations from the present climates of the relevant areas and the degree of impact they are likely to have on human living.

Glacial phenomena are known to have consequent modifications of the landscape in prePleistocene geological times, as they have in the Pleistocene. The evidence for this is found in deposits all over the world, including Pakistan and peninsular India. For example, thick sheets of ice once formed compact boulder beds in the Salt Range and extended up to the Aravalli range beyond the Thar region, as well as in the areas east of Punjab. An earlier ice age may have affected even the peninsular India. In Pakistan, the Pashtun country and Baluchistan mountain ranges could have also been affected by earlier glaciations but traces of these events have been largely erased by the Pleistocene glaciers, which can be readily recognized today by polished and striated rock beds, Ushaped valleys, deserted cirques, moraines, and drumlins (rounded hills of glacial debris).

Pleistocene Record of Pakistan - Research Work in the Pothwar Plateau: Pleistocene

environment of Pakistan and the changing climatic conditions during this time period are of utmost importance in the study of the first appearance of humans in this part of the world, the role of geography in channeling the dispersal of early humans across this region, and its demographic relationship with other parts of the Old World. Unfortunately, we find that the issue of Pleistocene ecology and its effect on the dispersal of humans and their colonization of this region has not attracted much attention in various reviews that have appeared from time to time. Few have paid attention to the environmental factors that may have aided or impeded the processes of human dispersal and even fewer have focused on environmental conditions, which may have favored or discouraged permanent colonization of this region by the expanding population of early humans, Ronin Dennell being a notable exception (9,10,11)

One reason for this neglect is probably a lack of research in this part of the world. Although considerable geological work has been done in Pothwar and in Kashmir by de Terra and Paterson, and later by Salim and others, the Pleistocene of Pakistan is not a well-researched topic among prehistorians or archaeologists working in the area. A lot that we know about this epoch comes to us as deductions from the work undertaken elsewhere, especially in Europe. Since ecological changes were more or less global in nature, such indirect readings are definitely not out of place.

Having lamented the situation, one can, nevertheless, say that in recent years some research efforts have been expended in uncovering the Paleolithic of Pakistan and India and sporadic work, primarily in conjunction with the prospecting for oil and gas, is being undertaken in geological surveys of Pakistan, India, Bangladesh and Nepal. Most of these results confirm the geological continuity of South Asia and conform to an ecological picture of the Pleistocene that one gathers from a global survey. Barring a few regional peculiarities, therefore, the study of the Pleistocene ecology in Pakistan should benefit from a Pleistocene survey of South Asia as a whole. James and Petraglia (12) have attempted such an overview and Robin Denell (11) has reviewed several studies in context with the biogeography of South Asia, especially Pakistan and India. Another recent review is from Korisettar and Rajaguru (8). Bridget and Raymond Allchin set the stage for these discussions in their *The Rise of Civilization in India and Pakistan*, from where some of the following introductory material is being reproduced

That the Himalayas are relatively young mountains; and that the Siwaliks and the Salt range are even younger, consisting as they do of folded Pliocene and early Pleistocene sediments, is generally accepted. The dramatically distorted folding of strata revealed by torrents cutting through the Salt range, and the curious phenomenon of walls of residual hardened Siwalik sediments, lifted from the horizontal to the perpendicular by intense folding, and now protruding from the surface of the Pothwar plateau - both bear eloquent witness to the force of recent tectonic activity.

The Pothwar plateau, situated between the Indus and the Jhelum in the northern Punjab, offers a great deal of evidence of past environment that differed in many respects from that we see today. The problem for the archaeologist is to read this evidence correctly in terms of the association of stone industries and climatic episodes represented in the geological record, and then to try to work out and assess the ecology of each cultural phase as far as the evidence will allow. All this has to be done on an interdisciplinary basis in cooperation with experts in other fields, particularly geology, in this case.

Evidence that the Himalayan glaciers had formerly descended several hundred feet below their

present termini was noted over a century ago. Subsequent studies of the Pleistocene geology of certain regions, such as that of the Kashmir valley by de Terra and Paterson and the Swat valley by Porter, for example, have shown in each case a series of old terminal moraines, below the present confines of the glaciers, related to terrace systems within their respective valleys. These appear to indicate major climatic changes generally comparable to those that took place in Europe and North America. This does not mean that they can be taken as representing a precisely corresponding sequence of events, as the climatic history of every major region of the world has been affected by many factors; and even where the same factors are at work some may be more pronounced in one region and others in another.

4th glaciation	T4	pink loam, silt, gravel	fluvial sedimentation
3rd interglacial	T3	thin loam	erosion/warping
3rd glaciation	T2	Potwar loessic silt and gravel	aeolian, fluvial, lacustrine
2nd interglacial	T1	upper terrace gravel	
		erosion/tilting/folding	
2nd glaciation	Boulder Conglomerate		fluvial and fluvioglacial sedimentation
	erosion/tilting/folding		
1st interglacial	Pinjor Beds conglomerates, sands, clays		
1st glaciation	Tatrot Beds conglomerates and sands		

Relative chronology of the Pleistocene deposits of the Pothwar plateau, according to de Terra and Paterson (1939)

In the 1930s, the Yale-Cambridge expedition was launched in British India by de Terra and Paterson (1939). Their primary goal was to look for evidence of Pleistocene glaciation in the Himalayan region and to highlight its impact on early human cultures. The expedition was not, however, limited to the Himalayan region alone, but was also extended to central India and around Madras. These were the areas where prehistoric as well as paleontological research had been occasionally carried out between 1880 and 1920. Following their field work in the Kashmir Valley (Jhelum), on the Pothwar plateau (Soan Valley), in the central Narmada Valley (between the towns of Hoshangabad and Narsinghpur) and around Madras they arrived at a fourfold glacial-interglacial model for northern Pakistan that was correlated with the Alpine glacial-interglacial model. The basis for their model was provided by the terraces in the Soan Valley. The possible correlation between the Alpine and Himalayan glacialinterglacial terrace sequences was adopted by Movius (1944) and was further extended to the Pleistocene sequence in northern Burma, northern China and equatorial Java. The fourfold sequence of glaciation and deglaciation in the Pathway region, as envisioned by de Terra and Paterson is given in the table below.This glacial-interglacial scheme became a standard yardstick

for prehistoric and Pleistocene research in the subcontinent for at least forty years.

de Terra and Paterson also highlighted the evidence for climate-related deposits in the Soan Valley. This enabled them to relate such deposits to glaciation and deglaciation in the Himalayan region. The Siwalik Boulder Conglomerate was assigned to the period of Mindel glaciation, and this provided a

Modified Relative Chronology of the Siwalik and Pleistocene Deposits of the Middle Soan Valley (*after R.Rendell***)**

two separate geographic entities (see Section V). The Boulder Conglomerate zone of Pothwar was considered a marker unit in the Quaternary correlations. Furthermore, there were efforts either to refute or to subscribe to their Pleistocene stratigraphic model. This is clearly reflected in the works of Krishnaswami (13) Zeuner (14), Soundara Rajan (15), Khatri (16), and Sankalia (17). This gradually led to a plethora of climatic interpretations presenting a confused picture of the Pleistocene period in Pakistan as well as that of India. Terms like Soanian, madrasian, mahadevian, abbevillian, clactonian, chellian and Acheulian were freely used for random collections of Paleolithic artifacts made from riverine sections, without going into their typotechnological and chronological implications. There was an apparent lack of uniformity in interpreting the climatic significance of various alluvial deposits, while the ubiquitous nature of the geological and

sedimentological context of the Lower Paleolithic certainly warranted a unified approach.

Table 2.1. *Relative chronology of the Pleistocene deposits of the Potwar plateau, according to de Terra and Paterson, 1939*

4th glaciation	T4	pink loam, silt, gravel	fluvial sedimentation
3rd interglacial	T3	thin loam	erosion/warping
3rd glaciation	T2	Potwar loessic silt and gravel	aeolian, fluvial, lacustrine
2nd interglacial	T1	upper terrace gravel	
		——— erosion/tilting/folding ———	
2nd glaciation		Boulder Conglomerate	fluvial and fluvioglacial sedimentation
		——— erosion/tilting/folding ———	
1st interglacial		Pinjor Beds conglomerates, sands, clays	
1st glaciation		Tatrot Beds conglomerates and sands	

Table 2.2. *Modified relative chronology of the Siwalik and Pleistocene deposits of the Middle Soan valley, after H. Rendell, 1982*

			Tentative dates
	——— erosion/deposition ———		
	Loess deposition		
	——— erosion/warping ———		– Middle Palaeolithic
	Lei Conglomerate Complex (valley fill) includes deposition of loess/uplift partly contemporaneous		(*c.* 40,000 yrs)
	——— uplift/folding/start of erosion ———		–0.7–0.5 million years ago
SIWALIK GROUP	Soan Formation	Upper Siwalik Conglomerates	– 1.9 mya
		Pinjor Beds	– 2.5 mya
		Tatrot Beds	
	——— diconformity ———		
	Dhok Pathan Formation		
	Nagri Formation		
	Chinji Formation		

The indiscriminate use of the term Boulder Conglomerate for the basal gravel of the Narmada also implied its similarity with the Soan sediment. Regional studies continued to be made in the 1970s,

primarily in the Pothwar Plateau where Salim did extensive work in elucidating the Middle Pleistocene environment and the the Middle Stone Age artifacts and adhering to the de Terra and Paterson's model. The British Archaeological Mission to Pakistan arrived in 1981 with much improved facilities and a remarkable

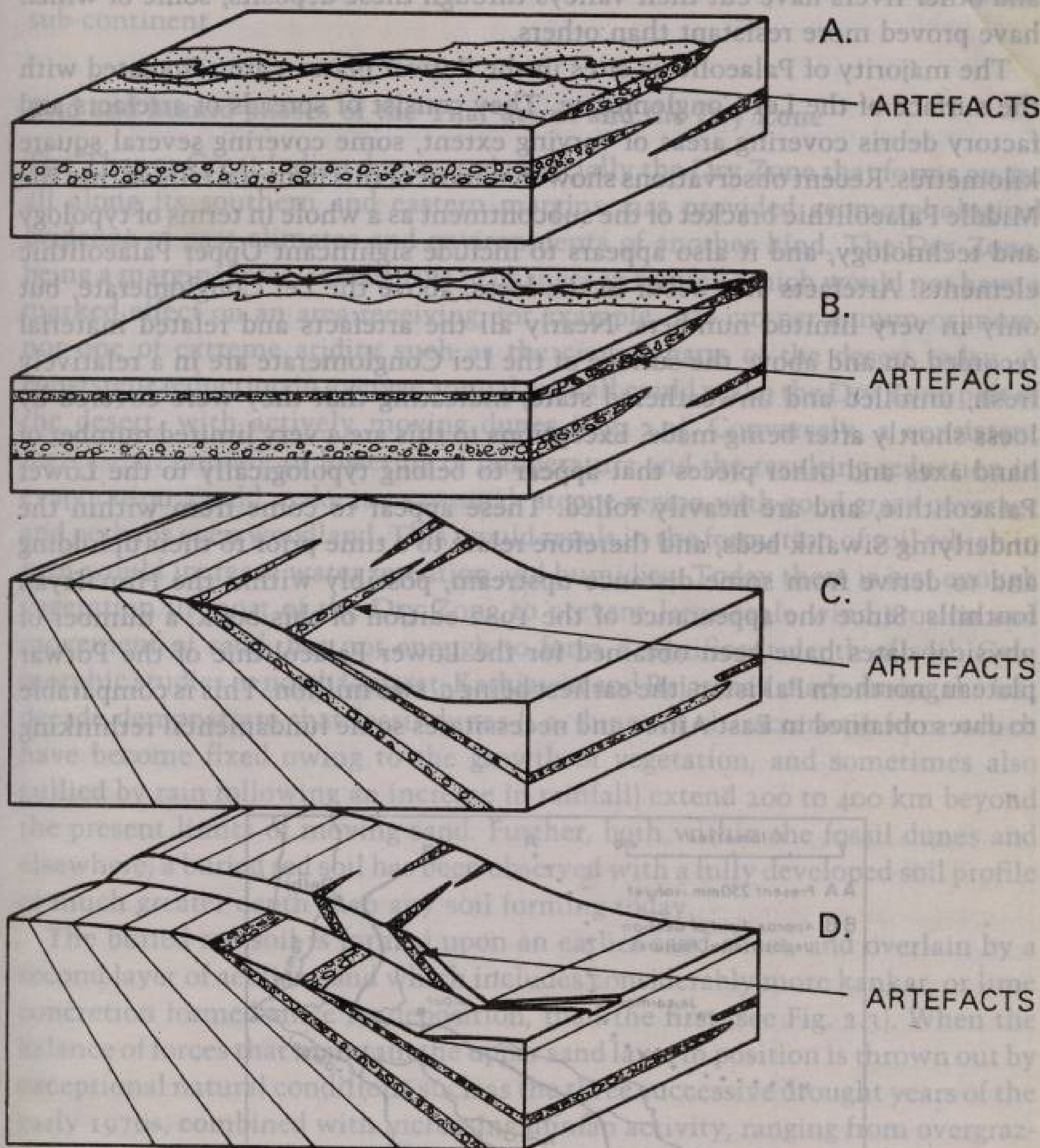


chronological basis for reconstructing the glacial sequence for the subcontinent. While Pinjore and Tatrot zones were placed in the Lower Pleistocene, the Boulder Conglomerate and the terraces were assigned to the Middle and Upper Pleistocene. Despite varying climatic, tectonic and sedimentary environments in the diverse physiographic zones of the subcontinent, de Terra and Paterson attempted a correlation of Pleistocene sequences. The sedimentary stratigraphy of the Narmada Valley was equated with the Pothwar depositional and erosional features, and, in addition, they extended stone age terminology to include core cultures.

There was no follow up of de Terra and Paterson's work in the ensuing several decades, as much attention was drawn to the unravelling of the Indus Civilization. However, the pervasive influence of their work continued to hold sway in throughout the region and there ensued a continuing debate on whether the Soanian and Acheulian periods were collection of talents. Their work

during the decade showed that none of de Terra and Paterson's findings can be sustained (18). The Early Soan industry associated with terraces T1 and T2 was questioned on the basis of a cultural taxonomy. The paleomagnetic stratigraphy helped in dating some new Paleolithic discoveries in the time range of 500,000 to 400,000 years ago. These sites are associated with the Lei Conglomerate, which is much younger than the Boulder Conglomerate of the Upper Siwaliks. Eventually, Rendell *et al*. advanced a revised stratigraphy of the Pleistocene sequence, which is show below. Rendell *et al*. also argued that there was no evidence for the existence of independent Acheulian and Soanian technological traditions in the Pothwar region. The majority of prehistoric sites are located on the surface of the Lei and Siwalik conglomerates, which are covered by loess. A couple of Acheulian sites are clearly datable to between 700 and 400,000 years ago (19).

The work of de Terra and Paterson has formed the basis of much discussion and of fieldwork on the geomorphology and Pleistocene geology of the subcontinent in the past. The above referred work of Rendell and Dennel in Pothwar Plateau has made it abundantly clear that the picture of the late Pleistocene and early Holocene sequence put forward by de Terra and Paterson in the 1930s requires radical revision. Revision is particularly necessary from the archaeological point of view as Paterson's discussion of the stone artifacts, found there in such abundance, claimed to show that there was a general correspondence between their physical condition, typology and technology, and their position in the terrace sequence. From this he



2.1 Diagram illustrating the incorporation of artefacts into the Siwalik deposits (courtesy H. Rendell).
Key
A. Braided river environment; B. Burial by river deposits; C. Folding and erosion; D. Incision.

Diagram illustrating the incorporation of the Siwalik deposits (after H. Rendell**)**

postulated a number of minor sub-divisions, or stages for the Soan industries, in addition to a major cultural division into “Early” and “Late” Soan. The nature of such terraces as there are in the valleys of the Soan and other rivers that cross the Pothwar plateau has been shown by surveys made by the British Archaeological Mission to Pakistan in 1980 and 1981 to have little direct relationship to those of the Himalayan valleys. Some of the lower terraces in de Terra's sequence postdate the Paleolithic

cultures; while the so-called upper terraces seem to be due to other causes, and associated with the formation of the plateau. Therefore both the geological and the archaeological sequences constructed by de Terra and Paterson must be set aside, and other means found for working out sequential relationships and dating individual sites and cultural phases.

As stated above, the Pleistocene record of northern Pakistan and north-west India is represented by the Upper Siwaliks, or more specifically, the Pinjor Faunal Stage. This name derives from a locality near Chandigargh, India, on the IndiaPakistan borders although the Pinjor is best indicated in the Pabbi Hills and the Mangla-Samwal area of northern Pakistan (20). As elsewhere in southern Asia in the late Pliocene and early Pleistocene, conditions appear to have been generally moister than in later periods. Evidence that the Himalayan glaciers had formerly descended several hundred feet below their present termini was noted over a century ago. Subsequent studies of the Pleistocene geology of certain regions, such as that of Kashmir valley by de Terra and Paterson and the Swat valley by Porter, for example, have shown in each case a series of old terminal moraines, below the present confines of the glaciers.

The Pleistocene glaciers made important alterations in the topography of these regions, leveling hilly sections to low, rolling plains, both by erosion and by deposition of drift, eroding hollows that later became lakes, and forcing rivers to cut new channels by filling their former beds. In the areas adjacent to the glaciated region but itself not covered by ice, such as the foothills of the Siwaliks in northern Punjab, the Pleistocene was marked chiefly by erosion as well as filling in the low-lying areas with debris that the melting glaciers brought with them. Pothwar Plateau is one such formation. Here are some troughs that have been filled by as high as 25,000 feet debris thrown in by the retreating glaciers. There are also deep gullies that have been formed by the immense amounts of water that the melting glaciers uphills threw downhills. De Terra and Paterson have described the formation of the topography of Pothwar and the Salt Range in the Pleistocene epoch in details.

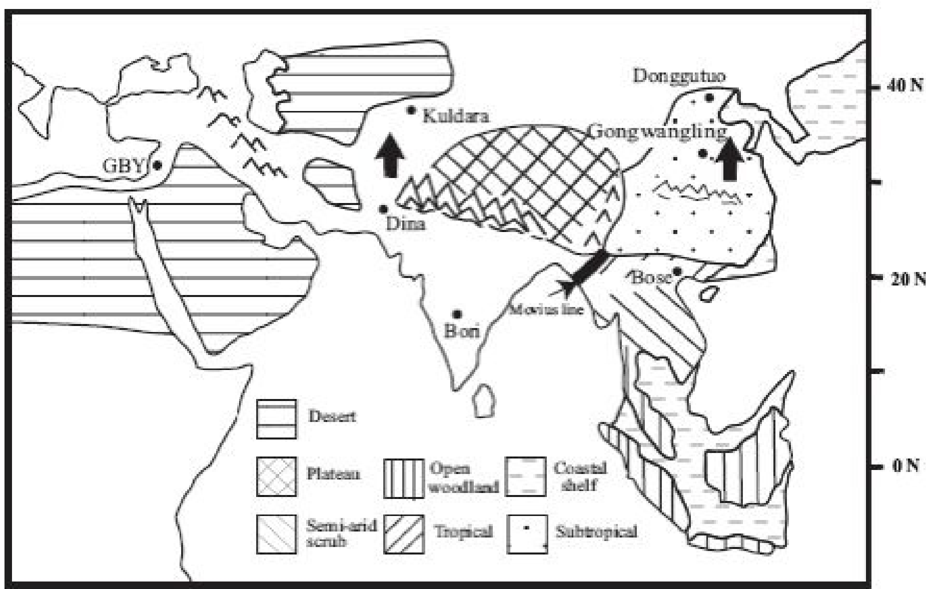
Apart from the foothills of the Himalayas, there is no geological evidence that any major area of Pakistan was ever subjected to the harsh environmentts of the Pleistocene. Nevertheless, tropical and subtropical areas of lower latitudes did undergo environmental changes during the Pleistocene. Deserts and forests changed their boundaries, water streams and rivers changed their courses, the patterns rain fall altered, and flora and fauna underwent corresponding change. All in all, it appears that major climate changes were generally comparable to those that took place in Europe and North America. This does not mean that they can be taken as representing a precisely corresponding sequence of events, as the climatic history of every major region of the world has been affected by many factors and even where the same factors are at work some may be more pronounced in one region and others in another.

Tectonic Activities: Apart from the erosional and depositional effects of glaciations and deglaciation, one must not loose sight of the tectonic activities in the north and the west that were so frequent in the Pleistocene. In fact, as Dennell (9) has argued, the scale of tectonic changes across south Asia during the Pleistocene have been seriously underestimated. The evidence shows that the changes that have occurred were on a far greater scale than the repeated, but generally, similar oscillations in Europe between glacial and interglacial conditions, or the muted changes in tropical Africa. Tectonic changes were particularly dramatic in the uplift of the Tibetan Plateau and the Himalayas-Karakorum mountain range but there were also smaller changes affecting in the Surinam and Kirthar ranges all along the western front of Pakistan. Some of these changes had major climatic consequences

As noted elsewhere in this book, the whole question of interpretation of the South Asian evidence is complicated by rapid uplift of the Himalayas, Tibetan plateau, the Pamirs
his world must have been fundamentally different from that we see today. Indeed, a number of fairly radical changes in the morphology of the landscape and drainage patterns of Pakistan may well have taken place since the beginning of settled agriculture, now considered to have taken place some seven millennia before the present time in the northwestern tributary valleys of the lower Indus.

The Continental "Savannaland": Dennel showed (9) that Arabia and Central Asia experienced a very limited desert cover in most part of the Pliestocene and a continuous grassland (shown in white in the figure below) existed between Asia and Africa. On this basis, it was suggested that hominids could have dispersed across Asian grasslands between 30N and 40N. The Himalayas and Tibetan Plateau would have confined hominids in South Asia to south of 25N. These environmental conditions would probably have encouraged the propagation of medium-sized bovids on which the hominids partially subsisted. Overall, hominids would have encountered essentially the same conditions as in

and other mountain ranges. Re cent research on earth sciences has shown that this was still taking place during Palaeolithic times. As already indicated, the rapidity, scale and relatively re cent date of this activity has only become apparent since the role of plate tectonics or 'Conti nental Drift' as a major factor in the shaping of these regions has been recognized. The rela tionship of past climates to such major tectonic activity is highly complex. At present all that can be said is that these changes must have had profound and far reaching effects not only upon the mountain regions but upon



the whole subcontinent, and
particularly upon the piedmont **Environmental conditions in South Asia during the Middle Pleistocene according to** regions adjacent to the moun
tains, of which the Potwar pla
teau forms part.

As reported by Allchin (2), the opinion has been expressed by a group of earth scientists visiting China that within the last twenty thousand years the rains of the South-west Monsoon were reaching the now desert region of Chinese Turkestan. This means that the Himalayas must have been significantly lower then than they are today in order to allow the rain-bearing Monsoon winds to cross them. The implications of this suggestion in terms of the subcontinent are many and various, and require much careful consideration, intelligent observation and research in the field and in the laboratory before they can begin to be fully appreciated. But one thing is clear from the outset: the environment of Paleolithic man in South Asia and the landscape of

Dennell (9)

East Africa, and their presence across southern Asia ca. 2.0–1.5 million years ago can be regarded as simply a latitudinal dispersion into the type of habitats they already utilized in East Africa.

If, as suggested, grasslands and a moister regime prevailed in the early Pleistocene, right across South Asia from Arabia to India, and northward to Central Asia and central China, and if the Red Sea and the Nile were less effective faunal barriers than now, Th.ere would have been little impediment to hominids extending their range eastward across south Asia. Current data are insufficient to establish the full extent of hominids in the Asian grasslands at this time. However, we might note that late Pliocene australopithecines are assumed to have been endemic to the African grasslands on a continental scale, and so we might cautiously assume that Homo should not be excluded from the possibility that they may have been resident in Asia at an early date. Dennell (10) and Turner (21) have both suggested, for example, that hominids might first have appeared in south Asia in the late Pliocene well before 2 million years ago, Aravalli range runs northeast southwest across the Thar. These most ancient of India's mountains divide the arid region into a western portion called Marwar and an eastern portion called Mewat. While the latter region is able to support a greater number of people today because of its moderate rainfall and its perennial flowing rivers, the western region is

drier and less densely populated, and its river, the

Luni, drains the region only during the monsoon season. Low hills and sand dunes characterize Marwar, but geological evidence indicates that there have been peri



odic cycles of moist-dry conditions prevailing here from Pleistocene to historic times. Crescent-shaped sand dunes that have become fixed in place by vegetation - the socalled fossil sand dunes - extended 400 km beyond the present limits of moving sand and active dune formation. These morphological features are also shared by eastern Sind in the South and the Cholistan Desert in the North of Sind. Thus when we talk about the western part of the Thar, it equally applies to the dry zone of Sindh and Cholistan in the eastern part of Pakistan.

A view from the Cholistan Desert in southeastern Punjab

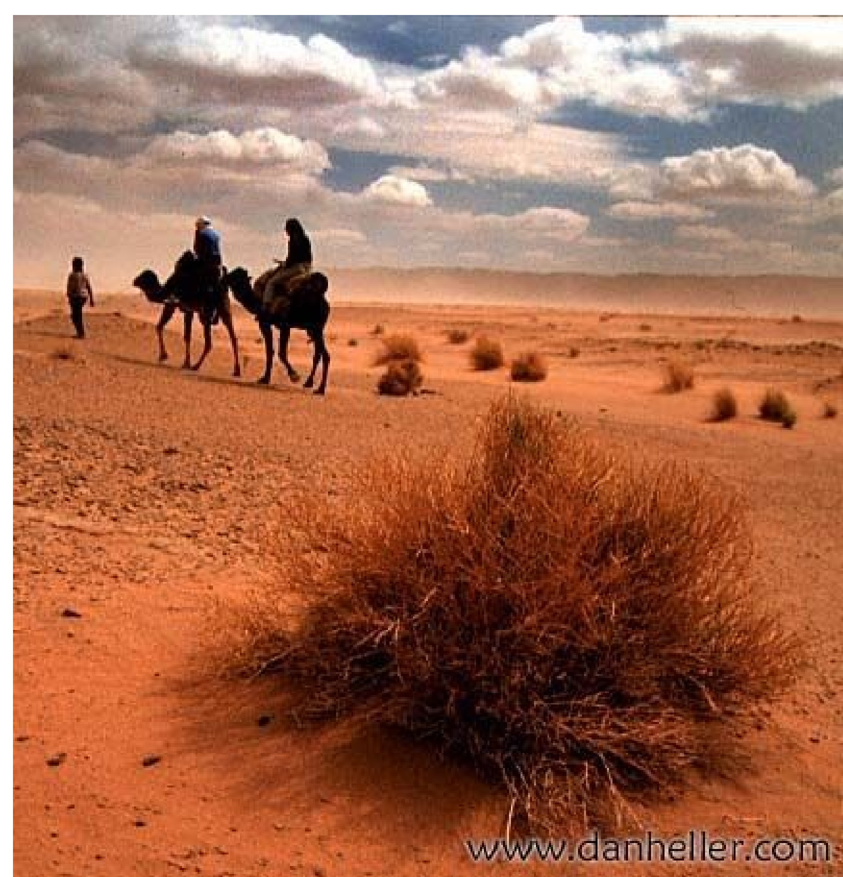
when conditions were more favorable than later. This is, however, a more radical idea than that rou tinely stated.

Fluctuating Dry Zone: It has been stated earlier that during the peak of the glaciation, a large amount of moisture would be sucked in by the ice sheet that covered an extensive area for a long pe riod of time. This would severely diminish the mois ture content of the air and frequency of rain or snowfall would be considerably reduced. The water level in oceans would fall. Conversely, a lot of mois ture would be released in the form of water during the deglaciation phase. The air would be moister; rain and the snowfall would be more frequent. The water level in the oceans would rise.

A cyclic variation of ocean level and the changes in moisture content and temperature of the air has been well documented all around the world. This has also been extensively studied in context with India and Pakistan and the results have been shown to have profound bearing on the activities of

ancient humans in the area. Paleoenvironmental data from both continental and oceanic records ap pear to indicate cycles of arid and humid conditions coupled with a trend toward increasing aridity as the Pleistocene progressed. Increasingly open envi ronments supplanted the mixed woodland and grassland ecosystems that characterized the Middle Pleistocene, with brackish swamps replacing plenti ful fresh-water sources.

The eastern sector of Pakistan is marked by the Thar, or the Great Indian Desert, which runs as a wide belt along the Pakistan-India borders. The



A photographic representation of the condition of man in a dry zone

Within the fossil dunes, mentioned above, are remnants of a buried red soil formed upon an earlier sand bed and overlain by a second layer of caeolian sand and high concentrations of kankar. When exposed by erosion or human activity, this buried soil is found to be compact, and consolidated, within it are prehistoric stone tools. This buried red soil testifies to the presence of a persistent and considerable vegetation cover on the ancient landscape, hence a period of greater humidity, reduced evaporation, and a more permanent supply of water in streams and lakes that allowed for settlement by prehistoric populations. These so-called fossil dunes became evident to the workers of the Geological Survey of India as early as the 1880s. Similar formations were recognized later in the Las Bela plains in south-eastern Baluchistan as well as in Gujarat. M.R.Mughal has described these dunes in details in his *Ancient Cholistan* (22) and Bridget Allchin and her associates have described them for the western Thar in their book *The Prehistory and Palaeogeography of the Great Indian Desert*

(5). Dune movement may have ceased by 10,000 years ago, because of sufficient vegetation cover. It is not surprising that permanent dunes became preferred camping places for late Pleistocene and early Holocene human populations in this part of the subcontinent (2,5,22).

Allchins convincingly showed (1,5) and Mughal (22) later verified that the Thar Desert experienced two major arid periods separated by a relatively wet period of some considerable duration in the Pleistocene epoch. The nature of the buried red soil shows that it must have carried a substantial vegetation cover throughout the year, and therefore have been formed under conditions of greater humidity than the present. This in turn implies an ample supply of surface water and game in areas where both are scarce today, making the Dry Zone and much of the desert an ideal habitat for hunters and gatherers.The existence and the structure of the so-called fossil dunes in the Thar, the adjoining area in Sindh and Cholistan in southern Punjab is the primary evidence for the “wet” interlude.

The climatic implications of the buried soil in the Dry Zone are corroborated by 'dead' drainage systems in the desert itself. These are not to be confused with abandoned channels of rivers that have changed their courses owing to river capture or other causes, but are the dried up channels of rivers and their tributaries forming complete, mature drainage systems, in which little or no water flows today. Many are blocked by sand dunes and when, following a rare downpour in the desert, water flows for a few hours in part of such a system it tends to pond up behind the dune, either becoming lost in the sand or forming a shallow lake or pond for a time until it.evaporates. In this way salt and gypsum deposits are formed in the desert today, and many such lakes are now asline or brackish.

Middle Paleolithic artifacts are associated widely with 'dead' rivers and streams in the desert, and so to a lesser extent are those of the Upper Paleolithic. Both Middle and Upper Paleolithic artifacts are also found at the rare outcrops of rock suitable for tool making that occur in the arid regions, notably the Rohri hills and Jerruk in Sindh, Mogara in south Rajasthan, and Nagri and Baridhani in central Rajasthan. The distribution of Middle Paleolithic artifacts extends to the arid region west of the Indus, where they have been recorded in the Bugti hills and Las Bela district. Mesolithic sites are found in profusion in the Dry Zone. They become progressively more sparsely distributed as one moves into the desert, but small sites continue to occur even in the most arid regions. They are frequently found on the crests of fossil dunes, showing that they were occupied only after the dunes had ceased to move.

Significantly, when the dry zones became habitable once more during the humid phase, the industries of the people who occupied it had a regional character. This means that the stone tools of this period in western arid zone (Sindh) were quite different from those of eastern borderlands (theMarwar). Intriguingly, the artifacts of Sindh and Cholistan seem to be more in common with those of the Middle Paleolithic of Afghanistan and central Asia than those found across the Aravalli mountain range, suggesting that their makers moved in from the North-west to fill the new hunting grounds, perhaps induced to do so by the increasing cold of the Hindu Kush mountain region during a period of colder conditions (2). Whether there was at the same time a movement of the animals that formed part of the regular diet of the Middle Paleolithic inhabitants of Afghanistan, notably sheep and goats, is an interesting question for future research but tentative reading of the relevant evidence indicates that it was (2). In any case, the differentiation of stone tools between the east and the west of the Thar inequitably argues for the non-interacting population groups residing in the two respective areas.

It has been shown that the occupation in the Thar Desert and the Dry Zone of Sindh became

increasingly sparse and isolated after *ca*. 25,000 years ago during the second dry spell of several thousand years duration, reflecting the heightened aridity and loss of available water sources at the height of the last glaciations. Whatever human population groups there have been, got concentrated around the perennial rivers, such as the Indus, isolated fresh water lakes (mostly on the west of the Indus), around water springs (such as those in the Kirthar Range), and on the slopes of Baluchi hills (such as at the eastern mouth of the Bolan Pass, across the Kachi plains). These were precisely the areas where we later detect the Mesolithic developments and still later the emergence of rudimentary agriculture and animal domestication.

A Recent Study: A comprehensive and multidisciplinary study has recently been reported by a large team of scientists, lead by Liviu Gaussian (28). The team studied the fluvial landscape of the Indus and Ganga-Jamuna basins and tied it up with the changing intensity of the monsoon rains. We reproduce here a few introductory paragraphs from this report.

"The Indo-Gangetic Plain (Fig. below) was built during the Cenozoic with sediments derived primarily from the Himalayas. Our digital elevation model shows a trend from aggradation in the eastern part of the Indo-Gangetic Plain toward incising rivers in the west (29), probably driven by the westward weakening of the monsoonal rains along the

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lowly incised valleys separated by interfluves characterize the Indus and its tributaries in Punjab as well as the Ganges and its westernmost tributaries.

The Old Beas Survey previously documented incision of the terminal Pleistocene sediments on

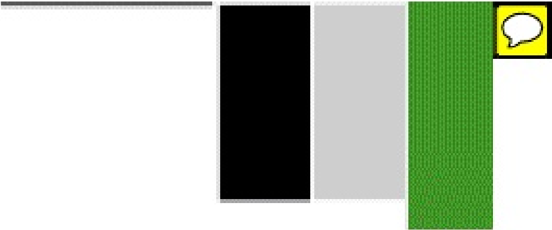
the Beas-Ravi interfluve at and near Harappa followed by stable conditions and occupation levels after approximately 7,700 years ago. On the inter 2012_Giosan_etal_P… the Sutlej River, or both rivers. However, the lack of fluves in Punjab, we dated the latest fluvial channel large-scale incision on the interfluve demonstrates deposits to approximately 10,000 years ago, con 10.7 MB that large, glacier-fed rivers did not flow across the

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The similarity of incision profiles for Indus
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other hand, high water discharge and sediment load

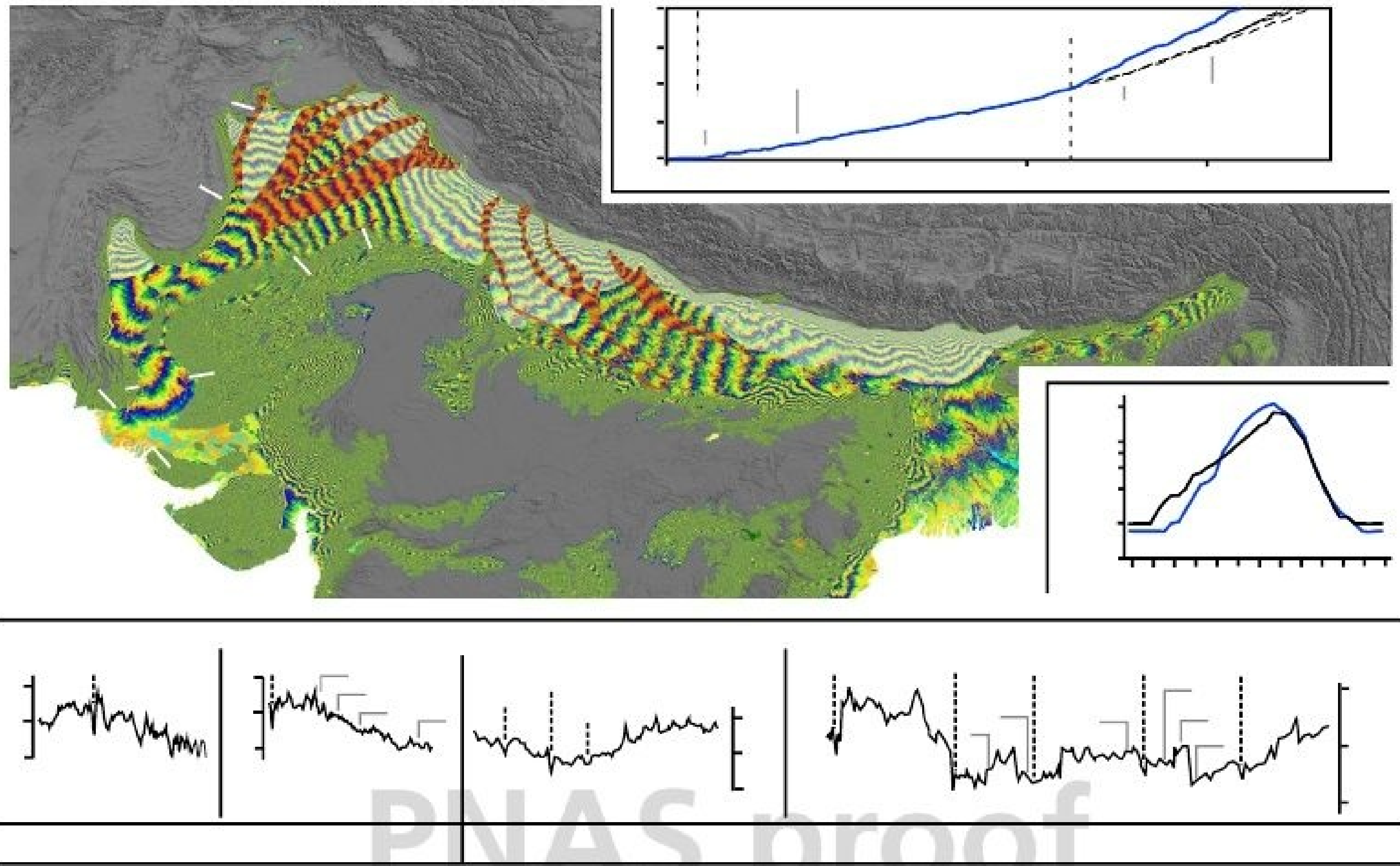
S$(I,$H(/$44#-+$)*#)/#(-,$7%*(@#(!**4#--#*^(FZH!.%`(%&.$-!)dI,$.^#*7^&'$ explain the relatively steep longitudinal profile of the
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E!6$)(R$7&#0(M9(P:]:>^ Indus. We note the sharp contrast between the deg

S,-(!46./%#(/$)6!.)-(-7++$46.)&(.)B$4H!6.$)($)%.)#(!6 radational character of the tributaries of the Indus
*$.`N:^N:P>e+)!-^NNN;P=>N:QeZeKLA7++%#H#)6!% and the Ganges in the Gangetic Plain and the lack



of wide incision valleys along the Ghaggar-Hakra interfluve. Numerous speculations have advanced the idea that the Ghaggar-Hakra fluvial system, at times identified with the lost mythical river of Sarasvati, was a large glacier-fed Himalayan river. Potential sources for this river include the Yamuna River,

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HC)?1 **Large-scale morphology of the Indus and Gangetic plains. Convex downslope, aggradational landscapes have a lighter mask, whereas incisional landscapes have red mask.**

firming that large-scale fluvial sedimentation ceased at the beginning of the Holocene. Within the entrenched river valleys, we mapped abandoned river channel belts and terraces, which indicate periodic but progressive incision. Our dates on incised valley deposits vary in age between 700 and 3,900 years. Thus, rivers in Punjab started to incise after 10,000 years ago, but before 3,900 years ago. As documented along the Himalayan course of the Sutlej River, the easternmost century-long phases of caused by weak monsoons were responsible for incision, primarily in the early Holocene between approximately 10;000 and 8,700 year ago. The presence of Harappan and even earlier settlements within these incised valleys also argues for major incision predating the Harappan. During Harappan times, the alluvial landscape in Punjab offered suitable terrain for floodwater farming within incised valleys and important protection against large floods on interfluves. tributary of the Indus, sediment load decline Ghaggar-Hakra region during the Holocene. Existing chronologies and our own age on the bank of Sutlej identified deposits of Late Pleistocene age, indicating that the interfluve formed instead during the last glacial period. Provenance detection suggests that the Yamuna may have contributed sediment to this region that seasonal monsoon flows

intensified episodically during the late Holocene and may provide an explanation for the high concentration of medieval fortified sites in this region.

Farther to the south, the five Punjab tributaries of the Indus merge to form the Panjnad River, before joining the Indus. Incision (4–5 m deep) between the two confluences and further south along the greater Indus separates vertically the modern floodplain and the southernmost extension of the Ghaggar-Hakra interfluve in the Cholistan region. Dunes younger than1,500 years old on the edge of the expanding Thar Desert have begun to cover this region of the interfluve, but sediment originating from the Indus-Punjab system, the Ghaggar-Hakra,

61 or from both of these river systems was deposited as late as 4,250 year ago. Zircon dating of sand in this confluence region indicates inputs from both Beas and Sutlej drainage basins. Continuing to the southwest on the Ghaggar-Hakra interfluve, we document well-watered lands in the region of Pat, where channels ran parallel with the Indus and joined the Nara valley; their deposits at Fakirabad, among the dunes of the expanding desert, are even younger at approximately 3;350 y old. Further south, the Nara valley, which would be currently dry if not for modern irrigation, also had active fluvial sedimentation approximately 2;900 years ago.

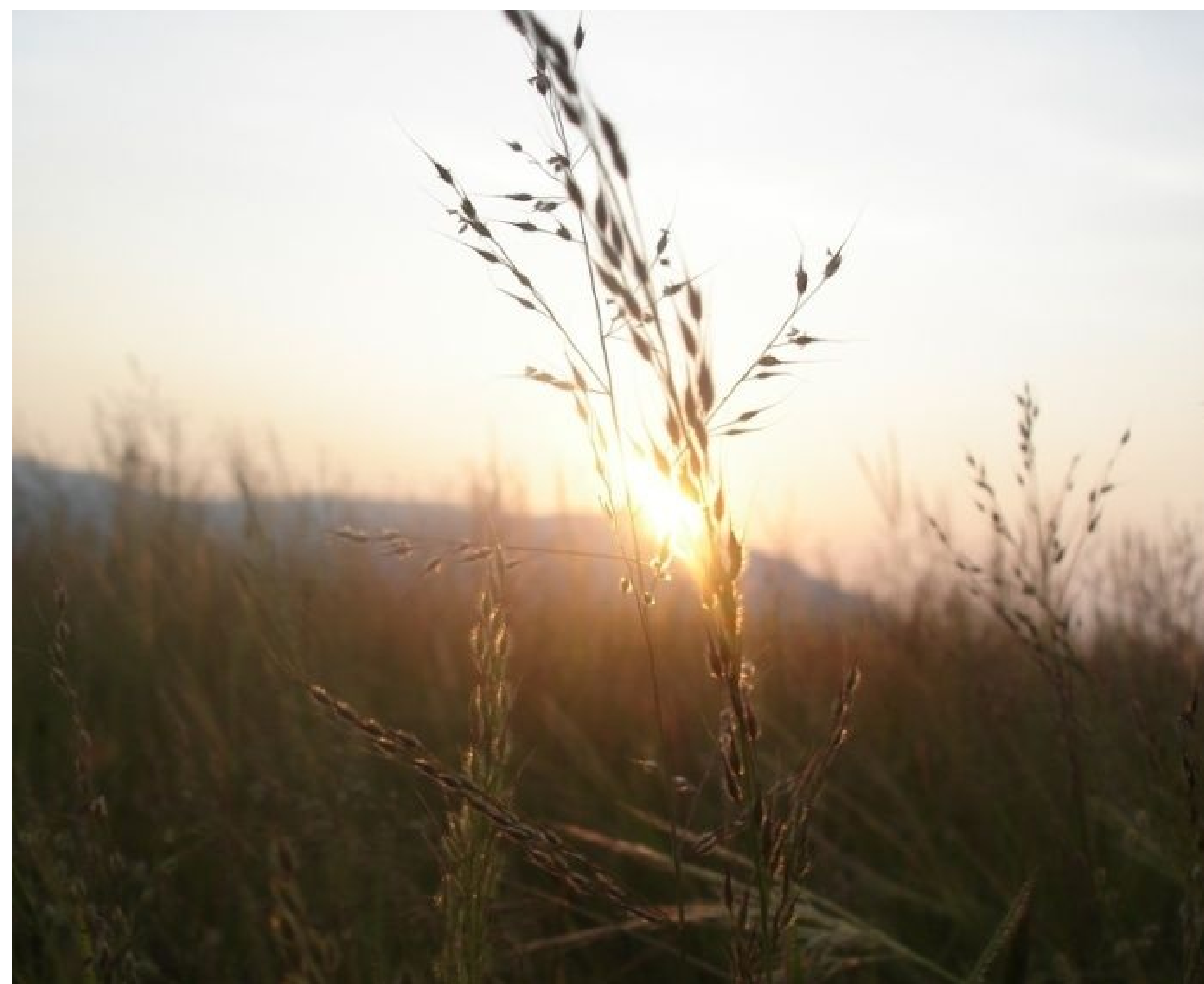
Downstream in the province of Sindh, the Indus River built a unique distributive-type fluvial system that we term the Indus fluvial mega-ridge. The alluvial plain here is convex up, showing maximum aggradation near the modern channel belt and tapering out toward the plain edges. The crosssectional relief of the ridge is very subdued and the river is stable on its apex because the thalweg is incised as deep as the ridge. Fossil channel belts and associated crevasse splays occur on both sides of the modern Indus course. Radiocarbon-dated fluvial deposits of old channel belts in lower Sindh indicate that aggradation was minimal during the late Holocene. This relative stability of the late Holocene landscape suggests that large avulsions of the Indus were rare and distributary channels acted mainly as overspills, as documented for the historical period. In contrast, sedimentation rates were at least three times higher between approximately 7,200 and 2,700 years ago compared to the last approximately 2,700.

We speculate that the development of the Indus fluvial mega-ridge was also the direct consequence of late Holocene aridity. Hydroclimate in the Indus Plain is influenced by both the Indian summer monsoon system and westerly winter disturbances bringing humidity from the Mediterranean, Black, and Caspian Seas. Most sediment is delivered to the Indus by floods after high-intensity monsoon storms, but the bulk of Indus water discharge is dependent on snow melt. The weakening of the monsoon after approximately 5,000 years ago compared to the slower decline in winter precipitation originating in western Asia must have resulted in a reduction in sediment load compared to water discharge, causing channel incision and stabilization and leading to longer intervals of decoupling between channels and the alluvial plain. The subdued relief of the fluvial ridge, resulting from less frequent breaches and overspills as well as cohesive banks, which are typical for arid regions, are not favorable to avulsions. Rarity of large scale avulsions reinforces deposition close to existing channel belts and allows for the slow growth of the mega-ridge. Within the deep active channels on top of the ridge, effective conveyance of sediments toward the coast for the build-up of a new deltaic depocenter in western lower Sindh must have diverted most of the sediment away from the Indus alluvial plain in the late Holocene.

Our analysis reveals a palimpsest of fluvial forms and deposits in the Indus Plain; however, one

constant trait that is evident across the entire Harappan land- scape is the change from a more energetic fluvial regime earlier in the Holocene (before approximately 5,000 years ago to increased stability of alluvial forms by Early Harappan times, and even drying up of some river channels during and after Harappan times" (29).

Post-Pleistocene Landscape: The postPleistocene period does not concern us here as our main subject but for the sake of temporal reference and historic continuity we shall touch upon it briefly nonetheless. The end of the Pleistocene and the beginning of the Holocene is an important landmark in the history of human development all over the Old World. This is the end of the so-called Ice Age and the beginning of a climate more or less like



Seed-bearing grasses were abundant in the dry zone of Sindh and Cholistan during the Pleistocene. They provide a subsistence base for the early humans. Some of

these grasses, such as barley and wheat were later domesticated and formed the basis of agriculture as we know it to-day.

ours. The improvement and diversity of the environment provided humanity the opportunity for cultural and technological experimentation which put it on the path of civilization.

The last glacial reached its maximum *ca.* 18,000-20,000 years ago. This was a time of maximum aridity in tropical and semitropical regions, including Pakistan, when many lakes and rivers dried up.

By about 15,000 years ago the ice sheet in the north started to lift, and the glaciers in high mountain ranges started to recede. At the same time, the rate of sea-level rise began to pick up, the seas became warmer and rainfall and humidity increased. Forests and grasslands spread into previously arid regions, deserts contracted, and rivers flowed more regularly, carrying silt in suspension rather than hauling coarse material when in spate. largely at the mercy of his environment. The The climatic conditions, however, did not get much changes in the environment that took place at the warmer for some time, because the temperature of end of the Pleistocene undoubtedly stimulated morePleistocene Environment and Climatic Changes the sea remained cold due to melting ice. It was resourceful human groups to advance and diversify probably around 10,000-12,000 years ago that a **their methods of winning a livelihood from the re**moderate climate started to prevail. This is indicated **sources of different environments.** by the pollen and oxygen isotope curves and other **Technically, the Stone Age ended with the** data, which show that the subcontinent experienced **end of the Pleistocene but culturally it lingered on** a cold and arid climate for the period of *ca.* 22,000 **into the Holocene where it is manifest in the small** to 15,000 years ago. **stone tools, the microliths, strewn all over Pakistan**

There is a correlation here with the Indus **as well as the borderlands of India, Afghanistan,** upper Paleolithic cultures of around 20,000 years **and Iran. On technological grounds, archaeologists**

ago. Following its peak before 18,000 years ago the
havehave designated thethe **post-Pleistocene** oror early
designated early

extent of prehistoric settlement is reduced in some **Holocene period as the *Mesolithic* (middle Stone** regions and was not re-established until mid**Age), which ushered the mankind into the Neolithic** Holocene times. This was a time when the north**(the New Stone Age). Although the term *Mesolithic*** eastern monsoon was strengthened and the south**maintains its value as a category of lithic industries** eastern monsoon was weakened. The Pir Panjal **predominant in early and middle Holocene times, it** range in the Siwaliks has been rising about 5,000 **does not define a specific post-Pleistocene culture** meters over the past 2.5 million years, thus forming **in Pakistan beyond the general characters of a** a barrier to the southwestern monsoon and conse**hunting-foraging lifeway from which developed in**quent climatic amelioration and better prospects for **cipient agricultural and pastoral practices. Because** upper Paleolithic settlement. This was now becom**of its importance as a transition stage between the** ing manifest in overall atmospheric conditions. **Paleolithic and the Neolithic or between the Pleisto**By 10,000 years or so, the ice cover of the **cene and the Holocene, we devote a full section to**

northern areas of Pakistan have been reduced sig**the Mesolithic in this volume.** nificantly and a lot of water had already rolled downhill changes gradually released from the weight and pressure of glaciers. Vegetation belts shifted northward, and
rain forests increased. With the establishment of
conditions much like those of the present, some
groups who had moved to newer territory, changed
In

summary,
Summary: the Pleistocene

In summary, the PleisThese climatic
in those areas,



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portant alterations in the topog
alterations in the topography of the
glaciated raphy of the glaciated regions, regions, leveling leveling hilly setions to low, roll
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ing plains, both by erosion and
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deposition of drift,
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became lakes, and forcing rivers to and forcing rivers to cut new channels by filling their their life-style with
changing conditions and were in cut new channels by filling their former beds. In the

a
position
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former beds. In the areas adjacent to the glaciated areas adjacent to the glaciated region but itself not
region but itself not covered by ice, such as the
arose. Their social structures started to form, and covered by ice, such as the foothills of the Siwaliks
soon they started to produce their food instead of
foothills of the Siwaliks in northern Pakistan, the
in northern Pakistan, the Pleistocene was marked

acquiring it from the wild. The level of their technol
Pleistocene was marked chiefly by erosion as well
chiefly by erosion as well as filling in the low-lying
ogy also started to improve rapidly. The survival of
as filling in the low-lying areas with debris that the
areas with debris that the melting glaciers brought melting glaciers brought with them. The Pleistocene
these late Pleistocene and early Holocene populawith them. The Pleistocene was accompanied by
tions was reinforced technologically by develop
was accompanied by periodic, sometimes severe,
periodic, sometimes severe, tectonic activities in the
ments
involving
miniaturization
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tools.
tectonic activities in the northern areas of Punjab
northern areas of Punjab and northwestern portion
These small-blade implements have stylistic paralof Baluchistan, elevating the existing and northwestern portion of Baluchistan, elevating mountain lels with the lithic products known in Europe and
the existing mountain peaks and generating new
peaks and generating new highlands. The Himala
western Asia as
microliths;
these became the hall
highlands. The Himalayas and the Pir Panjal ap
yas and the Pir Panjal approached their present
mark of a post-Paleolithic tradition, called
Meso
proached their present altitudes during the Pleisto
altitudes during the Pleistocene. Small lakes formed
lithic.
This is the stage at which man not only began
cene. Small lakes formed in various parts of the
in various parts of the Himalayas, although many of
to affect his environment, but also to control it to an
Himalayas, although many of these are dry today,
these are dry today, as a consequence of erosive
increasing extent.
as a consequence of erosive action of glaciers and
action of glaciers and damming of waters by mo
It is possible that by the end of the Pleistodamming of waters by moraines. Organic contents cene
human groups were bringing about changes in
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loessic deposits and their paleosols of thetheir paleosols of the Kashmir valley have been ratheir

environment, consciously or unconsciously, by
Kashmir valley have been radiocarbon dated and
diocarbon dated and indicate that the last deglacia
such means as burning off forest and grassland by
indicate that the last deglaciation of northern Paki
tion of northern Pakistan and Kashmir had com
accident or design; reducing certain species by ex
stan and Kashmir had commenced around 18,000
menced around 18,000 years ago (24), that is, the
cessive hunting or overkill, and thus altering the
years ago (24), that is, the peak of the latest glacia
peak of the latest glaciation before the onset of the
natural balance of wild life and the environment in
tion before the onset of the Holocene, was about
Holocene, was about 20,000 years ago.
general; and protecting and increasing the number
20,000 years ago.Tropical and subtropical areas of lower lati
Tropical and subtropical areas of lower lati
or range, or both, of other species. But it is more tudes also underwent environmental changes
durprobable that at this stage the effect of man upon
tudes also underwent environmental changes dur
ing the Pleistocene. Deserts and forests changed
his environment was marginal, only effective in par
ing the Pleistocene. Deserts and forests changed
their boundaries and alternate dry and wet condi
ticularly sensitive areas. In general, man was still
their boundaries and alternate dry and wet condi
tions seemed to have prevailed in the south. These
63
tions seemed to have prevailed in the south. These

changes are indicated by the presence of fossil dunes in the Cholistan and the Thar as well as on in the Las Bela plains in Baluchistan. Sea level decreased and increased as the moisture accumulated in the global ice sheet during glaciation and released changes can be observed in the geological marking on Baluchistan‘s grees of hydro-logical activity.

to the Arabian Sea. caused land elevation features of biogeography and climate in South Asia during the Pleistocene and postulated their implications in the dispersal of humans in this part of the world. The largest amount of dated vertebrate fossil material comes from the Pabbi Hills, in the Pothwar Plateau where over 40,000 specimens were collected by Dennell and his team (9), with roughly half from horizons between 1.8 and 2.2 million years ago and the rest from horizons 1.2–1.4 million years ago. The herbivores in this group were probably browsers, and their disappearance after 1.8 million years ago may indicate a contraction of woodland and the development of more arid conditions. The fauna is otherwise dominated by grassland and open woodland types, notably Rhinoceros; a variety of medium-sized bovids; gazells; elephants; stegodon; and showed an overwhelmingly C4 vegetation throughout the lower Pleistocene, which is indicative of open grassland.

Finally, it must be noted that there is increasing evidence for a regional variation in both temperature and humidity during and after glacial periods. For example, there were episodes of wetness in the desert environments of North Africa and Pakistan in OIS 4. These events extended to both century and millennium time scales, and their timing appears to lag deglaciation by approximately 3000 years, have increased at the end of OIS 4. These episodes would have led to an increase in vegetation and wildlife in what were formerly desert environments, and perhaps also attracted populations into regions that had previously been avoided. Rapid transitions between periods of aridity and wetness would have had an impact on the subsistence regimes and mobility of populations that may have resided in these regions at this time. Although the chronology and frequency of these events have not been fully ascertained for OIS 4, enough is known for the sake of the present taken from coastal Sindh show that in South Asia the climatic changes were highly complex. Some glacials were short while some were extra long, and some of the interglacial periods were warmer than today. changes are indicated by the presence of fossil dunes in the Cholistan and the Thar as well as on in the Las Bela plains in Baluchistan. Sea level decreased and increased as the moisture accumulated in the global ice sheet during glaciation and released during the warmer periods. These changes can be observed in the geological marking on Baluchistan‘s coastline, showing varying degrees of hydro-logical activity.

Dennell (9) has discussed some of the main features of biogeography and climate in South Asia during the Pleistocene and postulated their implications in the dispersal of humans in this part of the world. The largest amount of dated vertebrate fossil material comes from the Pabbi Hills, in the Pothwar Plateau where over 40,000 specimens were collected by Dennell and his team (9), with roughly half from horizons between 1.8 and 2.2 million years ago and the rest from horizons 1.2–1.4 million years ago. The herbivores in this group were probably browsers, and their disappearance after 1.8 million years ago may indicate a contraction of woodland and the development of more arid conditions. The fauna is otherwise dominated by grassland and open woodland types, notably Rhinoceros; a variety of medium-sized bovids; gazells; elephants; stegodon; and ostrich. Soil carbonate analyses (25) showed an overwhelmingly C4 vegetation throughout the lower Pleistocene, which is indicative of open grassland.

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I.5. Chronology



Few things are more important in archaeology and prehistory than chronology. At the same time, it is one of the most unstable and poorly known aspects of the story of man. This disappointment is compounded by the fact that there is no

agreed upon terminology for stages in the cultural development of early humans. As a result, the study the Stone Age is rather blurred and its various developmental stages are illdefined. The lack of agreement on the terminology of cultural change has meant that the prehistorians are forced to develop their own historical schema, with inevitable differences among them. None of these schemes is entirely satisfactory, in part because of the gradual increase in our knowledge and the differing assumptions, disciplinary predispositions and perspectives of those who created the schema. In this framework, the historian dons the cloak of a paleoanthropologist and traces the progress of man through the examination of his stone tools and the fossilized material that occasionally becomes available. Occasionally, he or she may seek help from archeogenetics. In so doing, though, the old three-fold classification of the Stone Age, the Bronze Age, and the Iron Age is still maintained and the three-stage division of the Stone Age (the Early, the Middle, and the Late Stone Age) or that of the Paleolithic (the Lower, the Middle, and the Upper Paleolithic); the Mesolithic thrown in for good measure), is maintained in one garb or the other. The reader will find the echos of this approach resonating throughout this book. The table below is a preview: it serves the purpose of putting a long period of time of human history in a neatly drawn picture. It is an imperfect method, because the stratigraphic information needed to be sure of necessary deductions is not always available and it depicts the prehistory as a linear progression. It is a good place to start, nevertheless.

What adds to the difficulties, and the interest, of this period of human history is that no absolute dating techniques were available till vey recent times. As a result the diverse structures of relative time used by early prehistorians are still common in the work of prehistorians today and many of the temporal structures developed at the time have remained central to the practice of prehistory.

In South Asia, of which Pakistan is a part, firm dates for the events and processes of cultural change are few; even these are largely based on comparative analyses and indirect inferences rather than on independent methods of age determination. The only consolation in dealing with the chronology of Stone Age is that we are concerned here with really long segments of time and geology can provide us with some answers about the age of the stone tools or fossilized bone fragments by determining the age of the soil which the given object was found embedded in. Of course, a few dates that have recently become available through various disciplines of physical sciences serve us as quite reliable signposts and largely tend to confirm our chronological deductions through other means.

As outlined by Chazan (26), the reflexive archaeological literature on concepts of time and chronology in dealing with the Stone Age has been sparse. This lack of consideration of time is in marked contrast to an extensive theoretical literature on other topics such as artifacts variability, symbolism, subsistence and social complexity. The neglect of time and chronology is largely a result

of the extreme interest in the shapes and styles of the stone tools, which the archeologist found during his or her excavations, and the surveys and techniques of making such tools.

This chapter aims to provide an overview of the basic principles that govern some key physical and chemical methods relevant in dating humanity's remote past. It complements monographs and articles that review the ever increasing and improving chronicetric methods available to researchers (23, 27).

Relative and Absolute Chronology: Chronology is of two types, *relative* and *absolute*. Relative chronology dates prehistoric events in relation to other events and geological deposits. It only tells us if a particular event is earlier or later than another event. Absolute chronology, on the other hand, dates events and phenomena in solar calendar years. Relative dating methods produce ages that can be ordered relative to one another but need to be calibrated against a numerical age to get anchored on a timescale. Numerical methods produce quantitative age estimates that can be placed on a standard timescale, commonly expressed as years before present (BP) or 'years ago'. This chronology is based on physical techniques and methods like radiocarbon, K/Ar analysis, fission tracks, thermo

strand of the complex web of concepts of time employed by prehistorians in even the most mundane

are independent approaches, yet they are mutually complementary. The stratigraphic approach leads to a relative age framework of layers and associated material remains. The second approach provides

results from attaching numerical age data to
stratigraphic sequence. Because of the methodological difficulties, this is not always possible. Here some educated guesswork and intuitive deductions events are detected in chronological order in a sedimentary column, it is possible to assign ages to

the corresponding depths and calculate the deposition rates. In some instances these conclusions are luminiscence, Th230/U234 studies, paleomagnetic possible to verify through radioisotopic techniques vides a chrono-sequence of events. Faunal markers reversals, and deep sea core studies. Radiocarbon were used, wherever possible, to correlate stra
dating, so common in archaeological work, can date and through these collaborations gather relevant tigraphic sequences, but the paucity of unambigu
ideas about the age of the artifact which has been

events up to sixty thousand years. It is, therefore, ous evidence, compounded by poor preservation of of limited use in the study of the Stone Age wherefound imbedded in the relevant geological layer.organic materials, renders this task difficult. Later the time scale is much longer. Its application is alsoArchaeologists often look for changes indevelopments involved somewhat more quantitative

chronol
dependent on the availability of suitable materials (but still relative) dating techniques utilizedartifact types in alluvial stratigraphies and place athat like wood, coal, charred vegetable material, and chemical changes in the organic remains due to given object in Lower, Middle and Upper Paleolithic volcanic ash at archaeological sites. Other methods oxidation/degeneration. Thus techniques such as have their own restrictions as they are not applica
the
fluorine

to
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ratio sequence. This is done on the assumption that the and sequential

ble in all circumstances. But, whenever they are changes in artifact forms should conform to thegrowth of hydration layers on obsidian became apapplicable, their temporal range is wide and theclassificatory sequence found in other parts of theplicable in dating. Among relative dating methods, gaze into the ancient past is more piercing.Old World. This assumption is, however, fraughtan important application came from the delineation

The earliest concept
which
stratigraphic
Cultural Stage Description Time Range
Faunal markers Stage One

Stone Age (the Paleolithic) Early Stone Age Middle Stone Age Later Stone Age 2,000,000 - 15,000 years ago 2,000,000 - 300,000 years ago

300,000 - 40,000 years ago 40,000 - 15,000 years ago
Stage Two Mesolithic Transition 15,000 - 8,000 BC materials, task difficult.
Stage Three Development of Agriculture 8,000 - 7,000 BC
Stage Four Settled Farming Communities 5,000 - 4,000 BC
Stage Five Early Harappan Cultures 3,500 - 2,500 BC organic re

niques such as the fluorine to phosphate ratio and sequential growth of hydration layers on obsidian became applicable in dating. Among relative dating methods, an important application came from the delineation of paleomagnetic stratigraphy of sedimentary deposits. This method has been exquisitely used in the chronological studies of the Pothwar

Geologists
rocks appeared in a layered sequence, a sequence tech
This by no means implies that in practice of paleomagnetic stratigraphy of sedimentary de prehistorians rely exclusively on absolute dates. On posits. This method has been exquisitely used in the contrary, absolute dating makes up only onewith a number of problems and does not always strand of the complex web of concepts of time em
deliver correct answer.
the chronological studies of the Pothwar stratigra

phy, to be discussed subsequently. As a result, the reliance on ployed by prehistorians in even the most mundanestratigraphic and typological methods has resultedoldest dating considerations. technique. Geologists realized thatin a low level of temporal precision. Many studies sedimentary

Stratigraphic and numerical dating methods
rocks appeared in a layered sequence, a sequence
have been based on alluvial sequences, where it is are independent approaches, yet they are mutually of strata, recognizable by their texture and/or color. complementary. The stratigraphic approach leads

todifficult to establish secure chronological controls. InPresumably older rocks are in the bottom layers,
a relative age framework of layers and associated
these cases, cross-correlation of deposits may be
and newer rocks in the top ones. This interpretation

material remains. The second approach provides tenuous, and regional marker horizons often cannotwas made possible by the discovery that simpler quantitative ages to individual horizons. Abe identified: this limits the usefulness of the inforfossil organisms were consistently found in deep *ogy* is the oldest dating mation for dating occurrences. For all these realayers while more complex ones, seen as more re realized results from attaching numerical age data to

that
sedimentary
stratigraphic sequence. Because of the methodocent fossils, were found in more shallow layers.
logical difficulties, this is not always possible. Here
sons, archaeologists are often uncertain about the Stratigraphic and typological correlation
some educated guesswork and intuitive deductions have been central to estimating the age range of
come into play.


archaeological occurrences in South Asia. Tempera

Relative Chronology:

[50]The earliest concept of
dating was based on the
law of superposition,
which reasons that the
deeper the stratum in the
stratigraphic sequence,
the older it is. This pro
ture, rainfall and humidity, the basic parameters of climate, leave behind their historical records in various living and non-living materials. Once these events are detected in chronological order in a sedimentary column, it is possible to assign ages to the corresponding depths and calculate the deposition rates. In some instances these conclusions are possible to verify through radioisotopic techniques and through these collaborations gather relevant ideas about the age of the artifact which has been
found imbedded in the relevant geological layer. Archaeologists often look for changes in
artifact types in alluvial stratigraphies and place a
given object in Lower, Middle and Upper Paleolithic
sequence. This is done on the assumption that the
changes in artifact forms should conform to the
classificatory sequence found in other parts of the
Old World. This assumption is, however, fraught
with a number of problems and does not always

deliver correct answer. As a result, the reliance on stratigraphic and typological methods has resulted in a low level of temporal precision. Many studies have been based on alluvial sequences, where it is difficult to establish secure chronological controls. In these cases, cross-correlation of deposits may be tenuous, and regional marker horizons often cannot be identified: this limits the usefulness of the information for dating occurrences. For all these reasons, archaeologists are often uncertain about the temporal relationship between Lower Paleolithic industries in different regions or the relative contemporaneity of multiple occurrences in the same valley.

Based on concepts and techniques developed on African and European assemblages, archaeologists working in South Asia divided stone tool industries by typology and manufacturing techniques in line with those used in Europe and Africa.

Sankalila, the grand master of Indian archaeology, for example, assumed that there should be changes in artifact types through time, and that this typology should be similar in India as that in Europe. This has led to an equally grand confusion in archaeological literature on India and Pakistan.

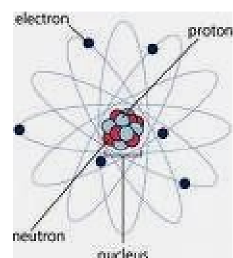
Using the techniques for relative chronology, early paleontologists had no way of knowing the absolute age of the fossils and rock layers they studied. They could only say that such and such stratum and its fossils appeared younger or older than another stratum. Nevertheless, many strata could be ordered in a relative chronological fashion and were given names representing geological eons, eras, epochs, periods, etc. This is why that in the early paleolithic research, the process of cultural development in any specific region was generally studied independently of any other region and no effort was made to even cross-reference the results to any other. We even find this easy-way-out in the so-called ‘processual archaeology‘ that was in vogue in sixties and seventies of the last century. Biostratigraphic research has been conducted in northern Pakistan that shows abundant evidence of taxonomic change during the PlioPleistocene, although no index fossils have been identified for subdividing the Pleistocene. Fluorine/phosphate ratios on bone and fossils have been atempt to supplement stratigraphic evidence and to differentiate Middle and Late Pleistocene sites.

Whilst chemical ratios may be useful in further supplementing stratigraphic evidence, the accuracy of these measures is undetermined, since little is known about paleoenvironments and depositional conditions, and further, few correlations have been made with absolute dates.

Methods based on the Radioactivity of

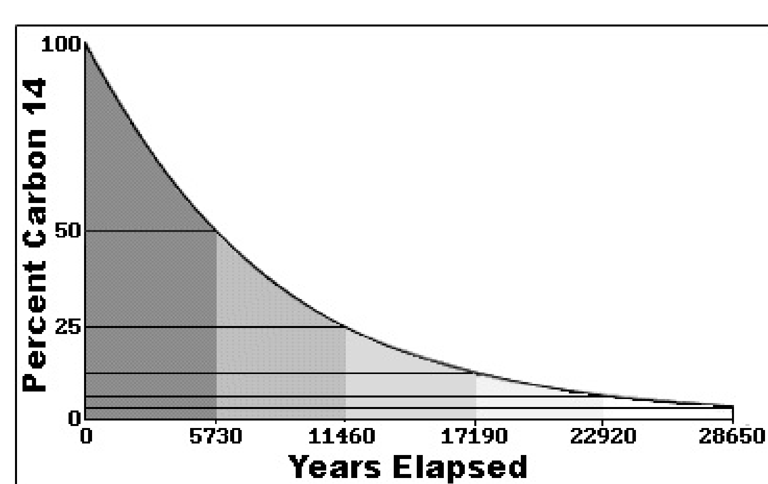
Certain Elements: All physical and chemical dating
methods are based on the measurement of a parameter that evolves with time in a continuous and
predictable manner. These methods of dating and
placing them in a chronological order are many but
the most common ones are based on the decay of
radio-isotopes. The principle of radioactive decay is
simple. In many instances, the presence of some
extra neutrons in the nucleus of an atom makes it
unstable and these nuclei disintegrate by giving off
subatomic particles that can be detected and
counted. This phenomenon is called *radioactivity*. It has been shown that radioactive decay
follows an exponential function (see figure below).
This means that radioactive isotopes can be characterized by their half-life, the period of time it takes
half of the atoms in a sample to decay. For example, carbon has two isotopes, of which C^{14} is
radioactive with a half-life of 5,715 years. Thus, if a sample has carbon element in it or is associated
with
debris that contain a carbonaceous material, its
date of origin can be determined by counting the
number of radioactive atoms left over since its formation. Thus, the amount of carbon-14
radioactivity
present in a sample tells us how old it is.
Although Rutherford first conceived the
idea of the applicability of natural radioactivity of
certain elements for dating as early as 1905, it was
Libby who laid the firm foundation of radiometric
chronology with his radiocarbon revolution in the
late 1940s. The radiocarbon revolution in archaeology later formed the basis of dating techniques
using other radio isotopes. The first radiometric assays, based on K/Ar, for hominid localities can be
traced to 1961. In addition, other chronometric
techniques, based on the radioactive decay of other
elements, have been developed to date Paleolithic
and later prehistoric sites.
The range of applicability is dependent on
the half-life of the isotope concerned and the sensitivity of the instrument to measure it. Radiocarbon
dating is perhaps the most frequently used method
in archaeology. The useful time range of the method
is about 40,000 years; beyond this a routine assay
is difficult owing to problems arising from low signal
to instrumental noise ration. Thus, this method is
quite often used in assaying the data that pertain to
the Late Stone Age investigations and most frequently in investigation of the Neolithic artifacts. A
related method is the K/Ar (Potassium/
Argon) dating. This method is perhaps the most
simple and, like C^{14} method relies on direct application of the radioactive decay, measuring a 'parent
nucleus decay into a ‘daughter’ nucleus. Because of
its much extended time scale, this technique is quite
useful in paleolithic work. Potassium (K) has a small

radioactive component, K^{40}, which has a half life of



1.2 billion years. K^{40} decays by two possible modes, namely Ar^{40} and Ca^{40}. Being an inert gas, Ar^{40} keeps accumulating in the lattice of potassium bearing mineral and does not form any chemical bonds. In suitable cases, Ar gas can remain in the lattice over geological time. This gas can be extracted by heating the mineral and can be measured using sensitive mass spectrometers. The estimation of K can be done using chemical analytical methods, and the time needed for mineral to accumulate the observed concentration of Ar^{40} can be estimated using simple relationship of Ar^{40}/K^{40}. The difficulty, however, arises due to measurement accuracy of Argon in the presence of any contaminating signal. Most of the applications have been based on the dating of different tephra layers that occur in between archaeological layers. Consequently, this method yields ages of the archaeological remains indirectly by providing ages to the strata that bracket the record. One of the recent applications has been the dating of the earliest hominid in Java. **Radiation-Exposure Dating Methods:** There are some other techniques for dating which also rely on radioactivity in one form or the other. Uranium-series dating of calcite formations in caves, electron spin resonance dating of tooth enamel, thermoluminescence dating of burnt stones and optically stimulated luminescence (OSL) dating of sun-bleached sediments have all been applied with varying success to archaeological sites over the past three decades. The magnetic reversal technique does not depend on radioactive decay but it needs a continuous deposit to detect polarity changes in the earth's magnetic field. Thermoluminescence dating, optically stimulated luminescence, and electron-spin resonance dating techniques need special mention. These methods are based on the measurement of trapped electronic charges that accumulate in crystalline materials as a result of low-level natural radioactivity present at sites. The three methods require materials whose trapped charges were “zeroed” at the date of site occupation, either by heating, by exposure to daylight (OSL dating) or by growth *de novo*, as in the case of ESR dating of teeth. The total radiation exposure ("dose") received by the sample is estimated by laboratory measurements, while the levels of radioactivity (annual "doses") in sites are determined by testing in areas near finds of the datable materials. Ages are ob
tained as the ratio of total dose to annual dose. These technique do not involve the measurement of radioactivity. Rather, they rely in the fact
that ubiquitous cosmic rays can literally knock electrons off the shells that surround atomic nuclei. These electrons are then trapped elsewhere in the mineral. With thermoluminescence, materials are heated in the laboratory to allow the trapped electrons to re-associate with their shells, a process which is accompanied by the emission of light, hence the name of the technique. The amount of light given off by the material is measured and is proportional to the number of dislodged electrons, that is, the amount of time that the material has been exposed to cosmic rays since the last time it
was heated.
Thermoluminescence is useful in dating
ancient pottery. In the process of making a ceramic
vessel, the soft clay vessel must be heated in a kiln
to harden it. The process of firing the vessel releases the trapped electrons (energy), and resets

the thermoluminesce clock to zero. The process of accumulation of electrons (energy) and then release when heated occurs every time the ceramic vessel is reheated. What an archaeologist would be able to measure using this technique is the last time the vessel was heated above 500 degrees, either at the time the vessel was first fired or the last time it was heated if it was used as a cooking vessel. In the laboratory, the release of electrons can be induced through heating or the use of a laser beam. In Optically Stimulated Luminescence (OSL) dating technique, the same technique as Thermoluminescence is applied except the sample grains are exposed to light rather than heated. OSL offers many adventges. It can capture ages of objects that originate or events that occurred during the entire Middle Stone Age. It produces ages with a precision of better than plus or minus 5 percent.
OSL exploits the fact that buried quartz grains absorb energy from natural ionizing radiation sources



A typical way of radioactive decay, using C^{14} as an example

(mainly uranium and thorium, their radioactive decay products, and potassium) in the surrounding ground. A small fraction of that energy is stored by electrons trapped at defects in the crystal structure of the grains. Using blue or green light, the electrons are released from their traps in the laboratory and the resulting OSL is detected with a filtered photomultiplier. This allows an estimate to be made of the equivalent radiation dose. By also measuring the rate of supply of ionizing radiation to the quartz grains from the surrounding deposit (the environmental dose rate), it is possible to calculate when the grains and nearby artifacts, whether they be stone tools or Stone Age ornaments, were buried

OSL dating was introduced by David Huntley and his colleagues in 1985, primarily to date geological sediments. But the method underwent a revolution near the turn of the century, when measurement procedures and instrumentation enabled equivalent radiation doses (and, by inference, burial ages) to be obtained from single grains of quartz as small as 0.1 millimeter in diameter. That made it feasible to routinely measure hundreds of individual grains for every sample, providing multiple, independent estimates of age that could be compared for self-consistency and any signs of sample contamination or disturbance.

Innovation of direct dating of sediments using TL or OSL opened up new possibilities for Paleolithic chronologies. This was because of the fact that Paleolithic artifacts were often found in sedimentary deposits such as dune sands and loess that were conventionally considered undatable. The dating of such burial contexts is now possible and can be used directly to determine the age of most archaeological horizons. The basic premise of luminescence dating application to sediments is that, during their predepositional transport, minerals get exposed to sunlight and their geological thermoluminescence gets zeroed.

The conceptual basis of electron spin resonance (ESR) or electron paramagnetic resonance dating is identical to that of luminescence dating. Both the techniques are related to detection of the concentration of trapped charges. In luminescence dating, these are measured by thermal or optical release of these charges and emission of luminescence consequent upon recombination at a different site. ESR dating, on the other hand, aims at detecting the trapped charge concentration by utilizing the fact that some of the trapped charges can be detected directly. Based on this fact, some sites with trapped charges act as free magnets, and these can be detected by placing the sample under a magnetic field. In the simplest case, these individual magnets can occupy two energy states when placed in a magnetic field, and it is in general possible to cause an energy transition of these magnets from an overall low energy state to an overall high energy state, using appropriate micro-wave energy. The amount of microwave energy absorbed is proportional to trapped charge concentration. The nature of the charge environment of individual magnets (and the nature of their own intrinsic magnetism) decides the details of the ESR absorption spectra. The ESR spectra is characteristic for individual types of trapping states.

Each type of trapped charge 'magnet' has its characteristic spectrum determined solely by its own magnetic properties and the charge environment around it. Thus signals from different defects in a mineral or from different phases in a sample can be readily identified. This implies that, besides minor effort in sample crushing, no other effort is needed to prepare the sample. Another aspect that merits mention is the fact that in general no heating is required and consequently even organic materials such as bones and teeth can be readily analyzed. The age equation for ESR dating is identical to that of luminescence dating, and the only difference is in respect of the fact that the equivalent dose is estimated using ESR as opposed to luminescence measurements.

Particle Tracks: Etchable tracks left by the passage of heavy ions through minerals are the base of two dating methods, namely the fissiontrack and alpha recoil track techniques. Whereas fission-tracks have already found many applications in Paleolithic research, the alpha recoil method is still in its infancy and, thus, less known.


An example of etched fission tracks in a rock

Fission-track dating is a relatively simple but robust method of radiometric dating that has made a significant impact on understanding the thermal history of continental crust, the timing of volcanic events, and the source and age of different archeological artifacts. Most current research using fission tracks are aimed at understanding: a) the evolution of mountain belts; b) the source or provenance of sediments; c) the thermal evolution of basins; d) determining the age of poorly dated strata; and e) dating and provenance determination of archeological artifacts. The usefulness of this as a dating technique stems from the tendency of some materials to lose their fission-track records when heated, thus producing samples that contain fissiontracks produced since they last cooled down. The useful age range of this technique is thought to range from 100 years to 100 million years before present, although error estimates are difficult to assess and rarely given. Generally it is thought to be most useful for dating in the window between 30,000 and 100, 000 years before present.

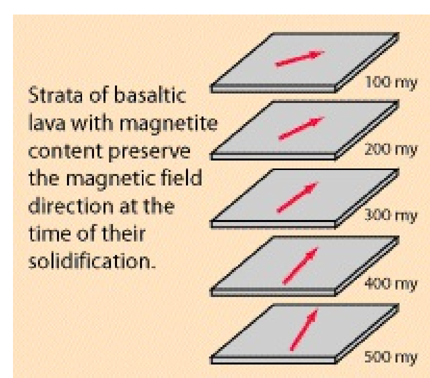
A fission-track (FT) is the radiationdamaged path left by two heavy fragments of uranium-fission. By chemical etching it is enlarged to a microscopically visible size. One distinguishes between *spontaneous* and *induced* fission-tracks. The spontaneous tracks are formed by the spontaneous fission of uranium-238 with a half-life of 8.2×10^{15} years. The tracks accumulate with time, and consequently their number is a measure of the elapsed time, i.e. the age of the material. Because the number of stored tracks depends also on uranium content, it is necessary to determine the induced tracks also. This is done by counting induced fission-tracks that are artificially formed by irradiating the sample with thermal neutrons, whereby uranium-235 undergoes induced fission. Because natural uranium consists of two isotopes, 235U (0.7 per cent) and 238U (99.3 per cent) with fixed abundance-ratio, the number of induced fissiontracks reveals implicitly the 238U-content. This means that fission-track dating depends essentially on counting tracks before and after a neutron irradiation. The tracks are counted under a petrographic microscope at high magnification.

Although many minerals and glasses contain fossil fission-tracks, only a few of them, mainly zircon, sphene and various glasses, are of practical interest for the prehistoric periods, because the uranium content needs to be high enough in order to produce a sufficient number of fission-tracks in the available 10^4 to 10^6 years. One of the materials well suited to archaeological application of the fission-track method is volcanic glass, such as obsidian.

During the alpha-decay of uranium and thorium, as well as of their decay products, the heavy nucleus is recoiled. As it traverses through the crystal lattice, it leaves a radiation-damaged trail: the alpha-recoil-track.The number of alpha-recoil-tracks is analogous to fission-tracks, a measure of the elapsed time. So far, etchable alpha-recoil-tracks have been observed only in micas. Due to the many contributing nuclides, alpha-recoil-track dating is methodologically more complex than fission-track dating. For this reason, there exist only a few studies dealing with this method.

Uranium-Series Dating: Uranium series methods exploit the phenomenon of radioactive equilibrium within the decay chains of 235U and 238U. Both these isotopes decay naturally to stable lead isotopes via various radioactive nuclides with different half-lives and different chemical properties. It can be easily seen that, if undisturbed for a long period, the different members of the decay chain reach a state of secular equilibrium, such that the activity of the parent and the progeny is the same all through the chain. If this chain is somehow disturbed chemically, or if a parent nuclide is deposited without the supporting daughter radio nuclide, then, after the chemical event, the decay of parent nuclei with the passage of time re-establishes the equilibrium. The time needed for this to happen is decided by the half-life of the daughter. Actually, after about five half-lives, the radioactive equilibrium is reestablished. From the degree to which the equilibrium is reached, the time elapsed since the event of disturbance can be readily calculated. The age represents the time of geochemical fractionation. In uranium-series dating, basically three types of isotope systems can be used. These are, 230Th/234U, 231Pa/235U and 234U/238U. The system 230Th/ 234U has been most extensively used in archaeological research. Uranium series dating is well suited for travertines, speleothems and pedogenic carbonates, some of which appear as occupational floors.

Paleomagnetism: As a matter of geological record, the Earth's magnetic field has undergone numerous reversals of polarity. We can see this in the magnetic patterns found in volcanic rocks, especially those recovered from the ocean floors. In the last 10 million years, there have been, on average, 4 or 5 reversals per million years. The latest one, the Brunhes–Matuyama reversal, occurred 780,000 years ago. Brief disruptions that do not result in reversal are called geomagnetic excursions



Schematic presentation of magnetic polarity record of in successive strata of deposited lava. The same principle would apply to other forms of rocks that contain magnetic minerals in their composition

Paleomagnetism is the study of the record of the Earth's magnetic field in rocks. Certain minerals in rocks lock-in a record of the direction and intensity of the magnetic field when they form. The record of geomagnetic reversals preserved in volcanic and sedimentary rocks sequences sediments provides a time-scale that is used as geochronology tool. Paleomagnetic dating is based on the fact that, during deposition of sediments, the constituent minerals record the direction of the ambient magnetic field

by orienting their own magnetic vector. This orientation predominantly occurs during the sinking of particles under quiet air or water columns. Upon sedimentation, the magnetic polarity acquired by the magnetic minerals is fixed, and subsequent reversals do not have any effect on the magnetization of the grains. This is known as detrital remanent magnetism (DRM). Thus in a long, continuously

three continents. Such a vast spatio-temporal treatment

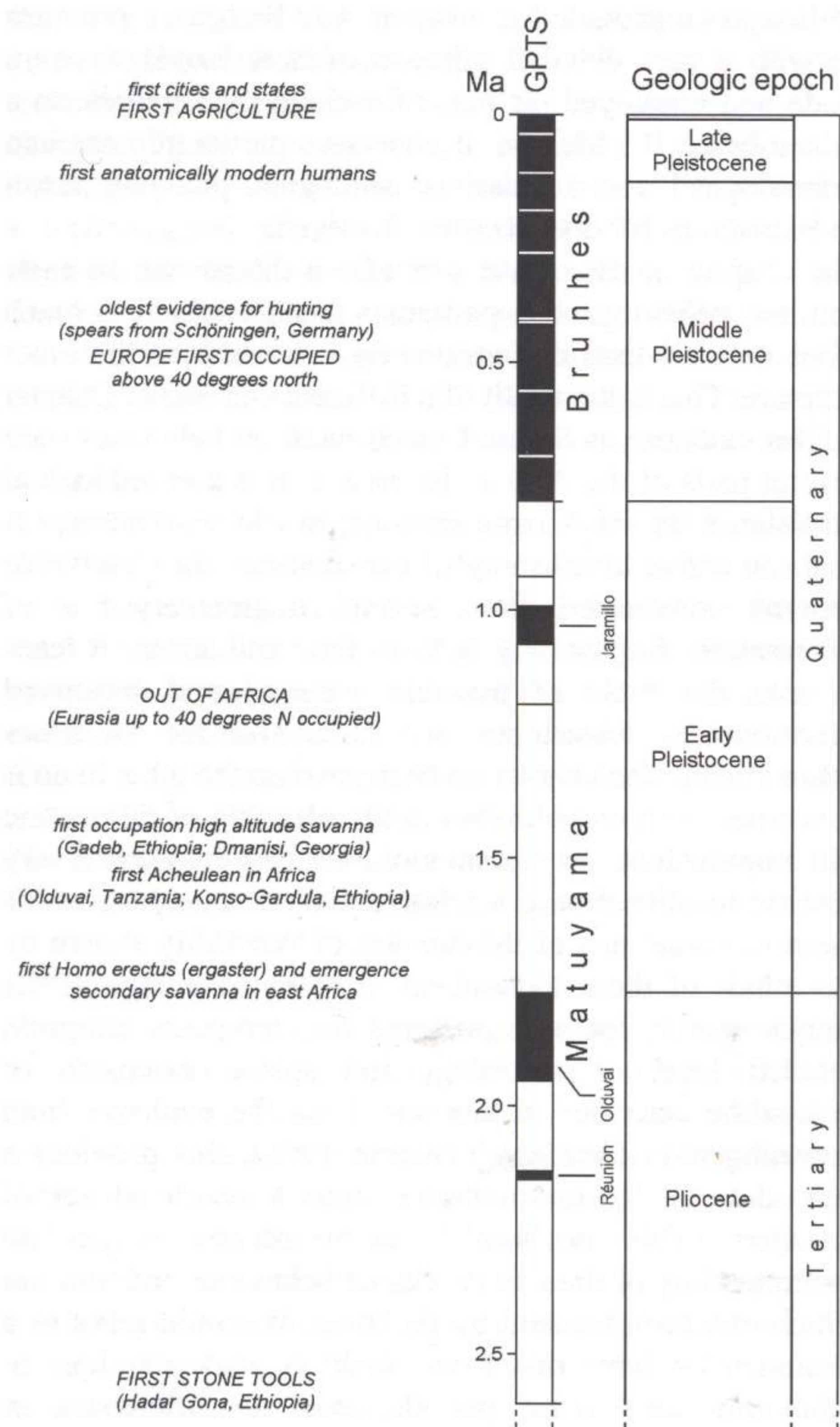


Figure 1: timeline, showing the chronological placement of chrons and subchrons of the Geomagnetic Polarity Time Scale (GPTS) and geological epochs to which frequent reference will be made in this work (Ma = million years. For sources on chronological boundaries, see main text). Some major events in the archaeological and palaeoanthropological records are indicated at left.

Geological timescale, showing the chronological placement of chrons and subchrons of the Geomagnetic Polarity Time Scale (GPTS) and geological epochs to which frequent reference is made throughout this book

deposited sedimentary sequence, a series of stratigraphic zones of normal and reversed or disturbed polarity occur. Any changes that occur in the magnetic field will occur all over the world; they can be used to correlate stratigraphic columns in different locations. This correlation process is called magnetostratigraphy.

The measurement of magnetic polarity begins with a careful sampling that comprises picking up undisturbed oriented blocks of rocks and carefully documented details of any evidence of their post-depositional tilting or rotation. The magnetic polarity of the samples is then read in either a spinner magnetometer or a cryogenic superconducting quantum interference device (SQUID) magnetometer. These instruments work on the principle that a rotating magnetic field can induce currents in the neighboring coils, such that the magnitude and direction of current depends on the magnet itself. This information is then used to establish a Paleolithic chronology in realtion to a faunal or radiometrically dated horizon. Based on this correlation, an age assignment to all other horizons is made provided that the sequence being dated represents a continuous sedimentary record. Further, if it can be assumed that the sedimentation rate remained constant through time, then it is possible to date any layer by simple interpolation.

The paleomagnetism provides some useful time markers which are valid worldwide, such as the Brunhes-Matuyama boundary at 0.78 million years ago, the Jaramillo subchron between 0.99 and 1.07 million years ago, and the Olduvai subchron between 1.78 and 1.96 million years ago. The Brunhes-Matuyama polarity reversal acts as the boundary between he Early and Middle Pleistocene. The upper Olduvai boundary acts as the boundary between the Pliocene and Pleistocene. The above two figures provides a synthetic summary of the most important chronological units and events referred to in this book.

Accuracy and Reliability *:* Dating debates often concern the technical aspects (e.g. laboratory procedures) of the chronological work carried out. Arguments range over the 'reliability' of a certain dating method and the chronological resolution obtained. Problems with geochronological dating in general as well as particular dating techniques have been discussed extensively by several authors but much less focus is on the field context of the dated materials, which is at least as important. While quoted standard deviations give some measure of the accuracy of the laboratory procedure to which the dated sample(s) has (have) been subjected, a small standard deviation does not necessarily indicate that the date(s) obtained is (are) very accurate with regard to the research question (the age of a fossil or artifact assemblage). Reworking of materials, sedimentary hiatuses or the formation of lag deposits can squeeze a large time-period into a small sedimentary unit or horizon, combining 'old' dates with much younger archaeological materials into one stratigraphic horizon or two closely associated stratigraphic horizons. Dates obtained by dating horizons situated 'just below' archaeological horizons are always suspect in this aspect. .

Equally important is the context of the artifacts or fossils to which a date is to be attached. A well-established, unambiguous *in situ* provenance is a fundamental requirement. A particular issue to be raised in the context of dating debates is the question how warranted the reliability attached to a certain dating method is. Almost all dating methods, be they 'absolute' physical dating methods or

'relative' methods like biostratigraphy, have their own particular problems that can be a source of error. In that sense, dating deposits can only be reliably done if several different dating methods are used to crosscheck each other. This is an important thing to note with regard to many presumed 'early' sites in southern Europe, East Asia, and the Soan Valley, which rely heavily on magnetostratigraphy for their claimed dates.

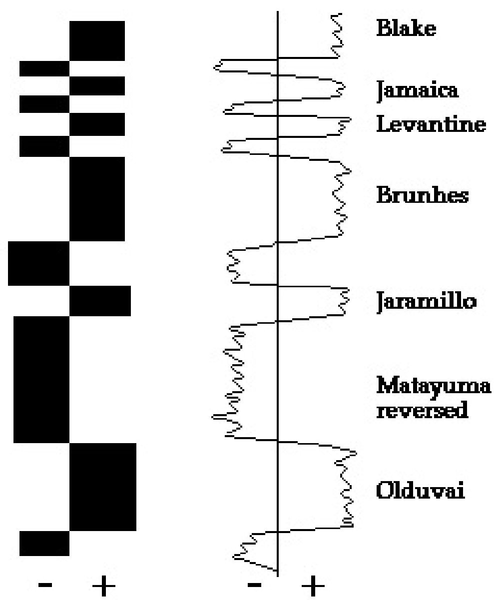
This is not the place to outline all potential problems with different dating techniques. Yet, these problems are of relevance when discussing the dating evidence of a particular site. The reader is referred to the standard work on dating techniques (21,88,89) as a source of information on particular dating techniques and their problems.

Apart from the question of accuracy and reliability, legitimate issues of discussion in the context of assessing evidence for early occupations are the genuine artificiality of recovered lithics, their correct geologic context, and the correct identification of presumed hominin remains. Questions have been raised (and will be raised in this work) on the archaeological content of some 'early' sites. Geofacts (lithics flaked by natural agents, not by hominins) are still a major source of confusion, simply because they are sometimes very difficult to distinguish from true artifacts. There are no technological flake criteria which are unique to anthropogene flaking processes. Geological flaking processes can produce flaked lithics with sometimes very convincing technological attributes like bulbs of percussion, ripple marks, and 'retouch'. Quite often, only the geological context of the reported specimens holds clues to their artificial/geoficial character. Therefore, one primary requirement is that each reported artifact occurrence is discussed with the proper geologic and lithostratigraphic details.

Chronological Haze: A general problem encountered in trying to date archaeological events or objects is that multiple, independent age estimates are typically more scattered than would be expected with normal statistical variation, even when margins of error for each estimate are considered. Much of this extra spread is an artifact of experimentation - an unwanted but unavoidable outcome of different materials being dated by different methods, using variable equipment, calibration standards, measurement procedures and dataanalysis techniques. This complication often arises even when a common set of samples (or a single sample) from one site is dated using the same technique in different laboratories. Unless all experimental reference identical, extra spread in results should be expected. We call this the chronological “haze” because it obscures the true age of the sample or event of interest.

Problems and Prospects: The problem of chronology in prehistory is manyfold and it finds its expression in many shapes. First of all: Is a given geological stratum belongs to the Tertiary period or the Quarternary period? If it belongs to the Quarternary period, as most of the sites of our interest do belong to Quarternary period, does it belong to the Early, the Middle, or the Late Pleistocene epoch? conditions, instrument

standards and analytical specifications, software are



Paleomagnrtism is usually displayed as north or south and is commonly represented as fluctuations in polarity.

Did we reach the decision on the basis of the stone artifacts or did we take the paleomagnetism into account, if such a mapping was available. Any of these considerations would put us in an approximate timeframe which is mostly relative.

Specimen are not always suitable for obtaining absolute dates through any physical method enumerated above. Even if the specimen or the surrounding soil or any associated article is suitable for the application of any one or more techniques for dating, the accuracy and precision of the reading often come in question. On top of it all, there are random variations to be content with. Nevertheless, the time frame is immense and points of reference are many. If all this effort puts us securely in one corner or the other, we, the students of prehistory, are generally satisfied.

It should be clear from the above that chronology of Stone Age sites and the collected assemblages of artifacts is generally not as clear cut or precise as it is often made to be. Judging when an archaeological tradition might have started and ended is not simple. It cannot be done solely from artifacts collected at one site because it is unlikely that the entire duration of an industry will be represented at one location. Archaeologists must assemble a series of "snapshots" from multiple sites to get a fix on first and last appearance dates. This is, however, easier said than done. Such coarsegrained chronologies leave plenty of room for imaginative speculation about the likely duration of various industries and their relations with the industries of another region.

Application in the Subcontinent: An intriguing question that remains unresolved to this day centers on the timing of the colonization of Pakistan and South Asia generally. Archaeologists working in Pakistan and India have traditionally relied on relative dating methods, although in recent years absolute dating techniques have been increasingly applied. The use of typological classifications of Paleolithic industries and in some cases their position within stratigraphic context has been common. Paleomagmetism has been used quite extensively in mapping the geological structure of Pothwar and the Salt Range in Pakistan and these studies have shed useful light on the chronology of some early paleolithic sites. Radiometric studies have been less common than in other parts of the world but they have not been absent. For example, extensive use of such techniques have been made in dating the cultural sequence of the Sangho Caves in the Peshawar Valley. Exotic chemical analysis of sand has

been used to reconstruct the course of water flow in ancient rivers. Carbon dating has successfully been used in dating some of the Mesolithic sites in Sindh. But, by and large, the paleolithic research in Pakistan as well as in India relies on typology of artifacts.

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SECTION II 

In Search of Adam (and Eve)

II.1. The Case of the Antiquity of Man
II.2. Human Evolution – An African Background II.3. The Earliest Inhabitants of Asia
II.4. Et tu Homo *sapiens!*
II.5. References

The Stone Age The Stone Age

II.0. In Search of Adam (and Eve)



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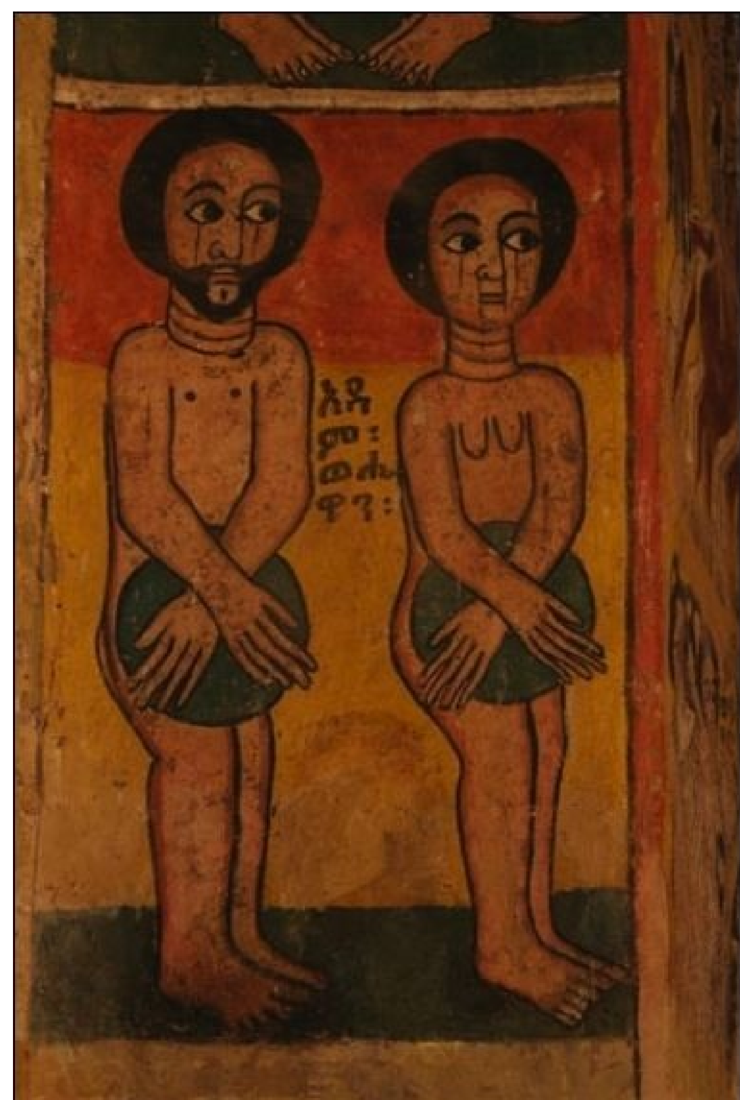
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II.1. The case of the Antiquity of Man



Where did man come from and when? This question has preoccupied human thought for thousands of years. It is responsible for a large number of myths and for many of the world's religions, each of these grounded in efforts to explain the creation of Earth and of men. Many of these explanations are exceedingly interesting and beautiful, but much of their details is no longer regarded as strictly factual. The story of creation, as told in the Bible and the Quran, is a fine case in point. It is seldom taken literally now. Its simple, sweeping concepts are interpreted by most modern Jews, Christians and Muslims as being symbolic of the spirit and majesty of God. The world, in fact, was not created in six days even though the scripture says it was, and this discrepancy no longer troubles most devout people. Similarly, few Jews, Christians, and Muslims now believe that God physically sculptured man from a lump of clay and blew into him His spirit, that God created Eve from one of the Adam's ribs, or that they both lived happily in a Heavenly Garden till they were thrown onto Earth to live there and toil. Even the 10th century scholars in the mosques of Baghdad and Damascus taught their students that these Quranic versus fell in the category of similes and allegories.

Along with the origin of man, the question of the age of Earth also vexed the curiosity of learned men. While the Hindus *rishis* sp.eculated that the universe had no beginning and no end, and while the Muslim *ulemas* avoided this question altogether, to the Jewish and the Christian men of knowledge the age of the earth was known to a nicety. It had been carefully calculated from Biblical references by Archbishop James Ussher of Armagh, Ireland, in 1650. His date for the morning



Expulsion of Adam and Eve from the Garden of Eden

of creation was 4004 B.C. Subsequently this was inserted in the margins of authorized versions of the Bible and before long came to acquire the infallibility of Scripture itself. Such a nicely constructed edifice, however, was to come crashing as the age of rationalism started taking its toll on unfounded myths and make-believe thoughts.

The Thunder-Stones: While the view of chronology based upon the literal acceptance of Scripture texts was thus shaken by researches in Egypt, another line of observation and thought was slowly developed, even more fatal to the theological view. From a very early period there had been dug from the earth, in various parts of the world, strangely shaped masses of stone, some rudely chipped, some polished: in ancient times the larger of these were very often considered as thunderbolts, the smaller as arrows, and all of them as weapons which had been hurled by the gods and other supernatural personages. Hence a sort of sacredness attached to them. In Chaldea, they were built into the wall of temples; in Egypt, they were strung about the necks of the dead; in India, fine specimens are to this day seen upon altars, receiving prayers and sacrifices.

Naturally these beliefs were brought into the Christian mythology and adapted to it. During the Middle Ages: many of these well-wrought stones were venerated as weapons, which during the "war in heaven," had been used in driving forth Satan and his hosts; hence in the eleventh century an Emperor of the East sent to the Emperor of the West a "heaven axe"; and in the twelfth century a Bishop of Rennes asserted the value of thunder-stones as a divinelyappointed means of securing success in battle, safety on the sea, security against thunder, and immunity from unpleasant dreams. Even as late as the seventeenth century a French ambassador brought a stone hatchet, which still exists in the museum at Nancy, as a present to the Prince-Bishop of Verdun, and claimed for it health giving virtues.

In the last years of the sixteenth century Michael Mercati tried to prove that the "thunder stones," were weapons or implements of early races of men; but from some cause his book was not published until the following century, when other thinkers had begun to take up the same idea, and then it had to contend with a theory far more accordant with theologic modes of reasoning in science. This was the

theory of the learned Tollius, who in 1649 told the world that these chipped or smoothed stones were "generated in the sky by a fulgurous exhalation conglobed in a cloud by the circumposed humour."

But about the beginning of the eighteenth century a fact of great importance was quietly established. In the year 1715 a large pointed stone of black flint was found in contact with the bones of an elephant, in a gravel bed near Gray's Inn Lane, in London. The world in general paid no heed to this: if the attention of theologians was called to it, they dismissed it summarily with a reference to the Deluge of Noah; but the specimen was labelled, the circumstances regarding it were recorded, and both specimen and record carefully preserved.

In 1723 Jussieu addressed the French Academy on *The Origin and Uses of Thunderstones*. He showed that recent travelers from various parts of the world had brought a number of weapons and other implements of stone to France and that they were essentially similar to what in Europe had been known as "thunder-stones." A year later this fact was clinched into the scientific mind of France by the Jesuit Lafitau, who published a work showing the similarity between the customs of aborigines then existing in other lands and those of the early inhabitants of Europe. So began, in these works of Jussieu and Lafitau, the science of Comparitive Ethnography.

But it was at their own risk and peril that thinkers drew from these discoveries any conclusions as to the antiquity of man. Montesquieu, having ventured to hint, in an early edition of his *Persian Letters*, that the world might be much older than had been generally supposed, was soon made to feel danger both to his book and to himself, so that in succeeding editions he suppressed the passage. In 1730 Mabudel presented a paper to the French Academy of Inscriptions on the so-called "thunder-stones," and also presented a series of plates which showed that these were stone implements, which must have been used at an early period in human history. In 1778 Buffon, in his *Époques de la Nature*, intimated his belief that "thunder-stones" were made by early races of men; but he did not press this view, and the reason for his reserve was obvious enough: he had already one quarrel with the theologians on his hands, which had cost him dear-public retraction and humiliation. His declaration, therefore, attracted little notice.

In the year 1800 another fact came into the minds of thinking men in England. In that year John Frere presented to the London Society of Antiquaries sundry flint implements found in the clay beds near Hoxne: that they were of human make was certain, and, in view of the undisturbed depths in which they were found, the theory was suggested that the men who made them must have lived at a very ancient geological epoch; yet even this discovery and theory passed like a troublesome dream, and soon seemed to be forgotten. About twenty years later Dr. Buckland published a discussion of the subject, in the light of various discoveries in the drift and in caves. It received wide attention, but theology was soothed by his temporary concession that these striking relics of human handiwork, associated with the remains of various extinct animals, were proofs of the Deluge of Noah.

In 1823 Boué, of the Vienna Academy of Sciences, showed to Cuvier sundry human bones found deep in the alluvial deposits of the upper Rhine, and suggested that they were of an early geological period; this Cuvier virtually, if not explicitly, denied. Great as he was in his own field, he was not a great geologist; he, in fact, led geology astray for many years. Moreover, he lived in a time of reaction; it was the period of the restored Bourbons, of the Voltairean King Louis XVIII, governing to please orthodoxy. Boué's discovery was, therefore, at first opposed, then enveloped in studied silence. Cuvier evidently thought, as Voltaire had felt under similar circumstances, that "among wolves one

must howl a little"; and his leading disciple, Élie de Beaumont, who succeeded him in the sway over geological science in France, was even more opposed to the new view than his great master had been. Boué's discoveries were, therefore, apparently laid to rest forever.

In 1825 Kent's Cavern, near Torquay, was explored by the Rev. Mr. McEnery, a Roman Catholic clergyman, who seems to have been completely overawed by orthodox opinion in England and elsewhere; for, though he found human bones and implements mingled with remains of extinct animals, he kept his notes in manuscript, and they were only brought to light more than thirty years later by Mr. Vivian.The coming of Charles X, the last of the French Bourbons, to the throne, made the orthodox pressure even greater. It was the culmination of the reactionary period - the time in France when a clerical committee, sitting at the Tuileries, took such measures as were necessary to hold in check all science that was not perfectly "safe"; the time in Austria when Kaiser Franz made his famous declaration to sundry professors, that what he wanted of them was simply to train obedient subjects, and that those who did not make this their purpose would be dismissed; the time in Germany when Nicholas of Russia and the princelings and ministers under his control, from the King of Prussia downward, put forth all their might in behalf of "scriptural science"; the time in Italy when a scientific investigator, arriving at any conclusion distrusted by the Church, was sure of losing his place and in danger of losing his liberty; the time in England when what little science was taught was held in due submission to Archdeacon Paley; the time in the United States when the first thing essential in science was, that it be adjusted to the ideas of revival exhorters.

Yet men devoted to scientific truth labored on; and in 1828 Tournal, of Narbonne, discovered in the cavern of Bize specimens of human industry, with a fragment of a human skeleton, among bones of extinct animals. In the following year Christol published accounts of his excavations in the caverns of Gard; he had found in position, and under conditions which forbade the idea of afterdisturbance, human remains mixed with bones of the extinct hyena of the early Quaternary period. Little general notice was taken of this, for the reactionary orthodox atmosphere involved such discoveries in darkness.

But in the French Revolution of 1830 the old politico-theological system collapsed: Charles X and his advisers fled for their lives; the other continental monarchs got glimpses of new light; the priesthood in charge of education were put on their good behavior for a time, and a better era began. Under the constitutional monarchy of the house of Orleans in France and Belgium less attention was therefore paid by Government to the saving of souls; and we have in rapid succession new discoveries of remains of human industry, and even of human skeletons so mingled with bones of extinct animals as to give additional proofs that the origin of man was at a period vastly earlier than any which theologians had dreamed of.

A few years later the reactionary clerical influence against science in this field rallied again. Schmerling in 1833 had explored a multitude of caverns in Belgium, especially at Engis and Engihoul, and had found human skulls and bones closely associated with bones of extinct animals, such as the cave bear, hyena, elephant, and rhinoceros, while mingled with these were evidences of human workmanship in the shape of chipped flint implements; discoveries of a similar sort had been made by De Serres in France and by Lund in Brazil; but, at least as far as continental Europe was concerned, these discoveries were received with much coolness both by Catholic leaders of opinion in France and Belgium and by Protestant leaders in England and Holland. Schmerling himself appears to have been overawed, and gave forth a sort of apologetic theory, half scientific, half theologic,

vainly hoping to satisfy the clerical side. Nor was it much better in England. Sir Charles Lyell, so devoted a servant of prehistoric research thirty years later, was still holding out against it on the scientific side; and, as to the theological side, it was the period when that great churchman, Dean Cockburn, was insulting geologists from the pulpit of York Minster, and the Rev. Mellor Brown denouncing geology as "a black art," "a forbidden proveince"; and when, in America, Prof. Moses Stuart and others like him were belittling the work of Benjamin Silliman and Edward Hitchcock.

In 1840 Godwin Austin presented to the Royal Geological Society an account of his discoveries in Kent's Cavern, near Torquay, and especially of human bones and implements mingled with bones of the elephant, rhinoceros, cave bear, hyena, and other extinct animals; yet this memoir, like that of McEnery fifteen years before, found an atmosphere so unfavorable that it was not published.

The Flint Weapons and Implements: At the middle of the nineteenth century came the beginning of a new epoch in science - an epoch when all these earlier discoveries were to be interpreted by means of investigations in a different field: for, in 1847 a man previously unknown to the world at large, Boucher de Perthes, published at Paris the first volume of his work on *Celtic and Antediluvian Antiquities*, and in this he showed engravings of typical flint implements and weapons, of which he had discovered thousands upon thousands in the high drift beds near Abbeville, in northern France. The significance of this discovery was great indeedfar greater than Boucher himself at first supposed. The very title of his book showed that he at first regarded these implements and weapons as having belonged to men overwhelmed at the Deluge of Noah; but it was soon seen that they were something very different from proofs of the literal exactness of Genesis: for they were found in terraces at great heights above the river Somme, and, under any possible theory having regard to fact, must have been deposited there at a time when the river system of northern France was vastly different from anything known within the historic period. The whole discovery indicated a series of great geological changes since the time when these implements were made, requiring cycles of time compared to which the space allowed by the orthodox chronologists was as nothing.

His work was the result of over ten years of research and thought. Year after year a force of men under his direction had dug into these highterraced gravel deposits of the river Somme, and in his book he now gave, in the first full form, the results of his labor. So far as France was concerned, he was met at first by what he calls "a conspiracy of silence," and then by a contemptuous opposition among orthodox scientists, at the head of whom stood Élie de Beaumont. This heavy, sluggish opposition seemed immovable: nothing that Boucher could do or say appeared to lighten the pressure of the orthodox theological opinion behind it; not even his belief that these fossils were remains of men drowned at the Deluge of Noah, and that they were proofs of the literal exactness of Genesis seemed to help the matter. His opponents felt instinctively that such discoveries boded danger to the accepted view, and they were right: Boucher himself soon saw the folly of trying to account for them by the orthodox theory.

And it must be confessed that not a little force was added to the opposition by certain characteristics of Boucher de Perthes himself. Gifted, far-sighted, and vigorous as he was, he was his own worst enemy. Carried away by his own discoveries, he jumped to the most astounding conclusions. The engravings in the later volume of his great work, showing what he thought to be human features and inscriptions upon some of the flint implements, are worthy of a comic almanac; and at the National Museum of Archaeology at St. Germain, beneath the shelves bearing the remains which he discovered, which mark the beginning of a new epoch in science, are drawers containing specimens

hardly worthy of a penny museum, but from which he drew the most unwarranted inferences as to the language, religion, and usages of prehistoric man. Boucher triumphed none the less. Among his bitter opponents at first was Dr. Rigollot, who in 1855 searching earnestly for materials to refute the innovator, dug into the deposits of St. Acheul - and was converted: for he found implements similar to those of Abbeville, making still more certain the existence of man during the Drift period. So, too, Gaudry a year later made similar discoveries.

But most important was the evidence of the truth which now came from other parts of France and from other countries. The French leaders in geological science had been held back not only by awe of Cuvier but by recollections of Scheuchzer. Ridicule has always been a serious weapon in France, and the ridicule which finally overtook the supporters of the attempt of Scheuchzer, Mazurier, and others, to square geology with Genesis, was still remembered. From the great body of French geologists, therefore, Boucher secured at first no aid. His support came from the other side of the Channel. The most eminent English geologists, such as Falconer, Prestwich, and Lyell, visited the beds at Abbeville and St. Acheul, convinced themselves that the discoveries of Boucher, Rigollot, and their colleagues were real, and then quietly but firmly told England the truth.

And now there appeared a most effective ally in France. The arguments used against Boucher de Perthes and some of the other early investigators of bone caves had been that the implements found might have been washed about and turned over by great floods, and therefore that they might be of a recent period; but in 1861 Edward Lartet published an account of his own excavations at the Grotto of Aurignac, and the proof that man had existed in the time of the Quaternary animals was complete. This grotto had been carefully sealed in prehistoric times by a stone at its entrance; no interference from disturbing currents of water had been possible; and Lartet found, in place, bones of eight out of nine of the main species of animals which characterize the Quaternary period in Europe; and upon them marks of cutting implements, and in the midst of them coals and ashes. Close upon these came the excavations at Eyzies by Lartet and his English colleague, Christy. In both these men there was a carefulness in making researches and a sobriety in stating results which converted many of those who had been repelled by the enthusiasm of Boucher de Perthes. The two colleagues found in the stony deposits made by the water dropping from the roof of the cave at Eyzies the bones of numerous animals extinct or departed to arctic regions - one of these a vertebra of a reindeer with a flint lance-head still fast in it, and with these were found evidences of fire.

Discoveries like these were thoroughly convincing; yet there still remained here and there gainsayers in the supposed interest of Scripture, and these, in spite of the convincing array of facts, insisted that in some way, by some combination of circumstances, these bones of extinct animals of vastly remote periods might have been brought into connection with all these human bones and implements of human make in all these different places, refusing to admit that these ancient relics of men and animals were of the same period. Such gainsayers virtually adopted the reasoning of quaint old Persons, who, having maintained that God created the world "about five thousand sixe hundred and odd years age," added, "And if they aske what God was doing before this short number of yeares, we answer with St. Augustine replying to such curious questioners, that He was framing Hell for them." But a new class of discoveries came to silence this opposition. At La Madeleine in France, at the Kessler cave in Switzerland, and at various other places, were found rude but striking carvings and engravings on bone and stone representing sundry specimens of those long-vanished species; and these specimens, or casts of them, were soon to be seen in all the principal museums. They showed the hairy mammoth, the cave bear, and various other animals of the Quaternary period, carved rudely

but vigorously by contemporary men; and, to complete the significance of these discoveries, travelers returning from the icy regions of North America brought similar carvings of animals now existing in those regions, made by the Eskimos during their long arctic winters to-day.

Lyell and his Time: As a result of these discoveries and others like them, showing that man was not only contemporary with long-extinct animals of past geological epochs, but that he had already developed into a stage of culture above pure savagery, the tide of thought began to turn. Especially was this seen in 1863, when Lyell published the first edition of his *Geological Evidence of the Antiquity of Man*; and the fact that he had so long opposed the new ideas gave force to the clear and conclusive argument which led him to renounce his early scientific beliefs

Charles Lyell synthesize a theory from the growing avalanche of evidence that if the earth's mantel is now affected by wind and flowing water, by the action of frost, by volcanic activity, by faulting along lines of crustal weakness, by mountain building, then it stands to reason that such forces have been operating in a similar fashion in the past also. Thus, if one assumes the passage of immense amounts of time, this will explain the presence of such diverse strata as exist in the Earth's crust. The earth is constantly remaking itself, and the only reason we are not continually aware of it is that it happens so slowly. To a society accustomed to believing that the earth was only 6,000 years old, this was a staggering revelation.

Lyell's dealt with three scientific issues that had become prominent in the preceding decade: the age of the human race, the existence of ice ages, and the theory of evolution that was being popularized by Lamarck. Lyell used the book to reverse or modify his own long-held positions on all three issues. The book drew sharp criticism from two of Lyell's younger colleagues – paleontologist Hugh Falconer and archaeologist John Lubbock – who felt that Lyell had used their work too freely and acknowledged it too sparingly. It sold well, however, and helped to establish the new science of prehistoric archaeology in Great Britain.

Antiquity of Man had its greatest impact in the years immediately after its publication. Lyell's presentation and endorsement of the new evidence for human antiquity firmly established the theory as scientific orthodoxy. His integration of both ice ages and a very old human race into the (geologically) recent history of Earth was novel for its time, as was his presentation of archaeological data from continental Europe. Until the early 1860s, "archaeology" had been synonymous, in England, with the study of antiquity and the Middle Ages through artifacts. *Antiquity of Man* expanded it to include the study of prehistory.

The book's three-part structure meant, however, that it was quickly supplanted by more detailed works that followed in its wake. Lubbock's *Prehistoric Times* (1865), Darwin's The *Descent of Man* (1870), James Archibald Geike's *The Great Ice Age* (1874) and William Boyd Dawkins' *Early Man in Britain* (1880) became the standard works on the fields to which Lyell had introduced a generation of mid-Victorian readers.

The Science Presses Forward: Research among the evidences of man's existence in the early Quaternary, and possibly in the Tertiary period, was now pressed forward along the whole line. In 1864 Gabriel Mortillet founded his review devoted to this subject; and in 1865 the first of a series of scientific congresses devoted to such researches was held in Italy. These investigations went on vigorously in all parts of France and spread rapidly to other countries. The explorations which Dupont began in 1864, in the caves of Belgium, gave to the museum at Brussels eighty thousand flint

implements, forty thousand bones of animals of the Quaternary period, and a number of human skulls and bones found mingled with these remains. From Germany, Italy, Spain, America, India, and Egypt similar results were reported.

Especially noteworthy were the further explorations of the caves and drift throughout the British Islands. The discovery by Colonel Wood, in 1861, of flint tools in the same strata with bones of the earlier forms of the rhinoceros, was but typical of many. A thorough examination of the caverns of Brixham and Torquay, by Pengelly and others, made it still more evident that man had existed in the early Quaternary period. The existence of a period before the Glacial epoch or between different glacial epochs in England, when the Englishman was a savage, using rude stone tools, was then fully ascertained, and, what was more significant, there were clearly shown a gradation and evolution even in the history of that period. It was found that this ancient Stone epoch showed progress and development. In the upper layers of the caves, with remains of the reindeer, who, although he has migrated from these regions, still exists in more northern climates, were found stone implements revealing some little advance in civilization; next below these, sealed up in the stalagmite, came, as a rule, another layer, in which the remains of reindeer were rare and those of the mammoth more frequent, the implements found in this stratum being less skilfully made than those in the upper and more recent layers; and, finally, in the lowest levels, near the floors of these ancient caverns, with remains of the cave bear and others of the most ancient extinct animals, were found stone implements evidently of a yet ruder and earlier stage of human progress. No fairly unprejudiced man can
visit the cave and mu
seum at Torquay with
out being convinced
that there were a gra
dation and an evolu
tion in these begin
nings of human civili
zation. The evidence
is complete; the
masses of breccia
taken from the cave,
with the various soils,
implements, and
bones carefully kept in
place, put this pro
gress beyond a doubt.
All this indicated a

THE GEOLOGICAL EVIDENCES

OF

THE ANTIQUITY OF MAN

THE ORIGIN OF SPECIES BY VARIATION

BY SIR CHARLES LYELL, F.R.S.

ILLUSTRATED BY WOODCUTS

LONDON
JOHN MURRAY, ALBEMARLE STREET
1863

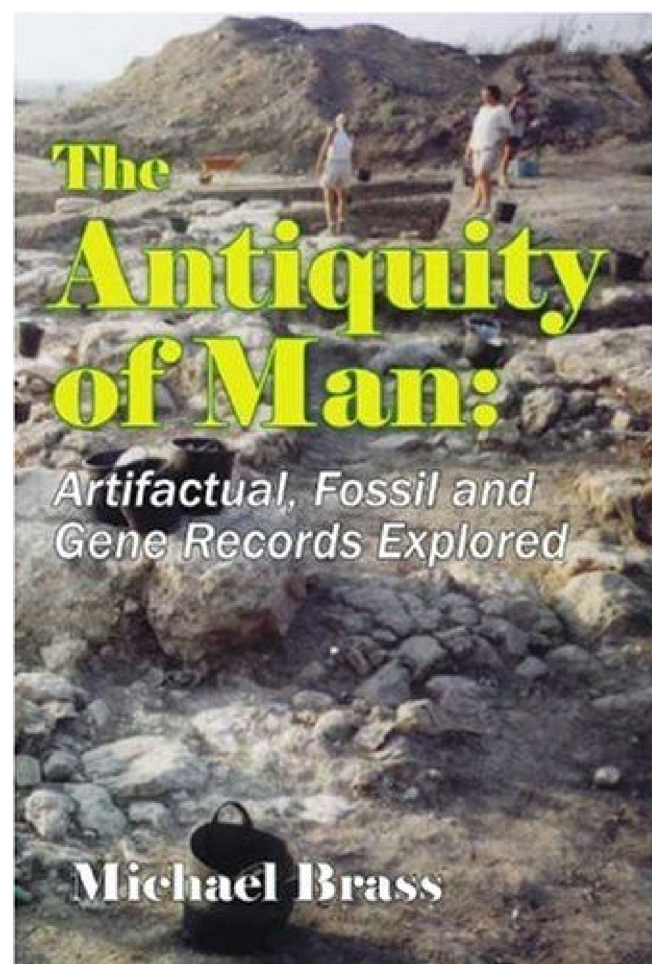
great antiquity for the
human race.

New evidences continued coming in, showing a yet greater antiquity of man. Remains of animals were found in connection with human remains, which showed not only that man was living in times more remote than the earlier of the new investigators had dared dream, but that some of these early periods of his existence must have been of immense length, embracing climatic changes betokening different geological periods; for with remains of fire and human implements and human bones were found not only bones of the hairy mammoth and cave bear, woolly rhinoceros, and reindeer, which could only have been deposited there in a time of

sapiens Plioarctic cold, but bones of the hyena, hippopotamus, sabre-toothed tiger, and the like, which could only have been deposited when there was in these regions a torrid climate. The conjunction of these remains clearly showed that man had lived in England early enough and long enough to pass through times when there was arctic cold and times when there was torrid heat; times when great glaciers stretched far down into England and indeed into the continent, and times when England had a land connection with the European continent, and the European continent with Africa, allowing tropical animals to migrate freely from Africa to the middle regions of England.

to Africa
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The question of the origin of man at a period vastly earlier than the sacred chronologists permitted was thus absolutely settled, but among the questions regarding the existence of man at a period yet more remote, the Drift period, there was one which for a time seemed to give the champions of science some difficulty. The orthodox leaders in the time of Boucher de Perthes, and for a considerable time afterward,

had a weapon of which they made vigorous use: the statement that no human bones had yet been discovered in the drift. The supporters of science naturally answered that few if any other bones as small as those of man had been found, and that this fact was an additional proof of the great length of the period since man had lived with the extinct animals; for, since specimens of human workmanship proved man's existence as fully as remains of his bones could do, the absence or even of human and other small bones simply indicated the long periods of time required for dissolving them away.

Yet Boucher, inspired by the genius he had already shown, and filled with the spirit of prophecy, declared that human bones would yet be found in the midst of the flint implements, and in 1863 he claimed that this prophecy had been fulfilled by the discovery at Moulin Quignon of a portion of a human jaw deep in the early Quaternary deposits. But his triumph was short-lived: the opposition ridiculed his discovery; they showed that he had offered a premium to his workmen for the discovery of human remains, and they naturally drew the inference that some tricky laborer had deceived him. The result of this was that the men of science felt obliged to acknowledge that the Moulin Quignon discovery was not proven. But before long human bones were found in the deposits of the early Quaternary period, or indeed of an earlier period, in various other parts of the world, and the question regarding the Moulin Quignon relic was of little importance.

We have seen that researches regarding the existence of prehistoric man in England and on the

Continent were at first mainly made in the caverns; but the existence of man in the earliest Quaternary period was confirmed on both sides of the English Channel, in a way even more striking, by the close examination of the drift and early gravel deposits. The results arrived at by Boucher de Perthes were amply confirmed in England. Rude stone implements were found in terraces a hundred feet and more above the levels at which various rivers of Great Britain now flow, and under circumstances which show that, at the time when they were deposited, the rivers of Great Britain in many cases were entirely different from those of the present period, and formed parts of the river system of the European continent. Researches in the high terraces above the Thames and the Ouse, as well as at other points in Great Britain, placed beyond a doubt the fact that man existed on the British Islands at a time when they were connected by solid land with the Continent, and made it clear that, within the period of the existence of man in northern Europe, a large portion of the British Islands had been sunk to depths between fifteen hundred and twenty-five hundred feet beneath the Northern Ocean, had risen again from the water, had formed part of the continent of Europe, and had been in unbroken connection with Africa, so that elephants, bears, tigers, lions, the rhinoceros and hippopotamus, of species now mainly extinct, had left their bones in the same deposits with human implements as far north as Yorkshire. Moreover, connected with this fact came in the new conviction, forced upon geologists by the more careful examination of the earth and its changes, that such elevations and depressions of Great Britain and other parts of the world were not necessarily the results of sudden cataclysms, but generally of slow processes extending through vast cycles of years, processes such as are now known to be going on in various parts of the world. Thus it was that the six or seven thousand years allowed by the most liberal theologians of former times were seen more and more clearly to be but a mere nothing in the long succession of ages since the appearance of man.

As an important supplement to these discoveries of ancient implements came sundry comparisons made by eminent physiologists between human skulls and bones found in different places and under circumstances showing vast antiquity. Human bones had been found under such circumstances as early as 1835 at Cannstadt near Stuttgart, and in 1856 in the Neanderthal near Dusseldorf; but in more recent searches they had been discovered in a multitude of places, especially in Germany, France, Belgium, England, the Caucasus, Africa, and North and South America. Comparison of these bones showed that even in that remote Quaternary period there were great differences of race, and here again came in an argument for the yet earlier existence of man on the earth; for long previous periods must have been required to develop such racial differences. Considerations of this kind gave a new impulse to the belief that man's existence might even date back into the Tertiary period. The evidence for this earlier origin of man was ably summed up, not only by its brilliant advocate, Mortillet, but by a former opponent, one of the most conservative of modern anthropologists, Quatrefages; and the conclusion arrived at by both was, that man did really exist in the Tertiary period. The acceptance of this conclusion was also seen in the more recent work of Alfred Russel Wallace, who, though very cautious and conservative, placed the origin of man not only in the Tertiary period, but in an earlier stage of it than most had dared assigneven in the Miocene.

The first thing raising a strong presumption, if not giving proof, that man existed in the Tertiary, was the fact that from all explored parts of the world came in more and more evidence that in the earlier Quaternary man existed in different, strongly marked races and in great numbers. From all regions which geologists had explored, even from those the most distant and different from each other, came this same evidence-from northern Europe to southern Africa; from France to China; from New Jersey to British Columbia; from British Columbia to Peru. The development of man in such numbers and in so many different regions, with such differences of race and at so early a period,

must have required a long previous time. This argument was strengthened by discoveries of bones bearing marks apparently made by cutting instruments, in the Tertiary formations of France and Italy, and by the discoveries of what were claimed to be flint implements by the Abbe Bourgeois in France, and of implements and human bones by Prof. Capellini in Italy.

On the other hand, some of the more cautious men of science are still content to say that the existence of man in the Tertiary period is not yet proven. As to his existence throughout the Quaternary epoch, no new proofs are needed; even so determined a supporter of the theological side as the Duke of Argyll has been forced to yield to the evidence.

Biological Evolution: Among the readers of Lyell's *Antiquity of Man*, as it was known to contemporary readers, was a young man named Charles Darwin, who, in another 26 years, was to publish an even more shattering book, *On the* Ori*gin of Species*. Like Lyell, Darwin organized a great amount of evidence into a theory. Impressed by the great variation in living organisms and aware of the obvious relationships of fossils in different strata of the earth, he began to speculate about how the different species now in existence might have become differentiated. He proposed a theory of evolution with natural selection as the principal mechanism that directed change. Darwin was an extremely cautious man and the evidence he used to support his theory was limited to plants and some animals but did not include man. He mentioned the origin of human beings only once in his entire book and in it he implied a parallelism between animals and man.

In the history of human knowledge, we have the emergence of two great and related ideas about the emergence of man: that the earth is an extremely ancient place, long populated by many kinds of animals, some of which are no longer living; and that man himself, a mutable creature like the animals, has his origins far back in time. But how far back, and who those ancestral men were, nobody as yet had even the slightest notion. These two events, directly or indirectly, are the very foundation of the discipline of paleoanthropology, which is the one great consolidator of modern scientific approaches to studies of our biological origins and diversity, the emergence of cultural behavior as mankind's most critical adaptive strategy, and our place in nature. Archaeology aids paleoanthropology in this quest and a recent scientific discipline, population genetics, gives a new dimension to the enquiry. The synthesis of Darwinian evolution and paleoanthrolopolgical findings with the science of genetics took place in the 1930s and 1940s. Since then, the whole scenario of man's cultural and biological evolution started to be seen against the background of the Pleistocene (the last *Ice Age*) environment, a time period to which thousands of the small stone tools, which Leyall had discovered, belonged. All this is a relatively recent development and everything that we now know about our ancestry we have learnt in the last century.

In 1863 Thomas H. Huxley published a book, *Man's Place in Nature*, that was the first to address itself in an orderly and scientific way to the problem of man's development. By making many telling anatomical comparisons between man and the apes, particularly the chimpanzee and gorilla, he established that these were the two living creatures that were the most closely related to man. He further established that the evolutionary development of apes and men had taken place in much the same way and according to the same laws. His book was followed in 1871 by another by Darwin, *The Descent of Man*. Both were widely misunderstood. Most people - and even some scientists, unfortunately - jumped to the conclusion that both Darwin and Huxley thought that men were descended directly from the living apes. In short, a person who accepted evolution apparently was obliged to believe that a chimpanzee or a gorilla was his ancestor. This was terribly disconcerting,

for man obviously was *not* an ape, and a widespread aversion to the idea that he might have been, doubtless held back acceptance of evolutionary theory. It also produced another bothersome misconception that was to plague anthropologists for decades - the idea of a *missing link*. If men were men and apes were apes, it was argued, the connection could be proved by discovering a fossil that stood halfway between the two. Unfortunately for the early proponents of the theory, no missing-link fossils were found, nor would they ever be, for we know today that while both men and apes are descendant from common ancestors, they bear the relationship of cousin to cousin and not grandparent to grandchild.

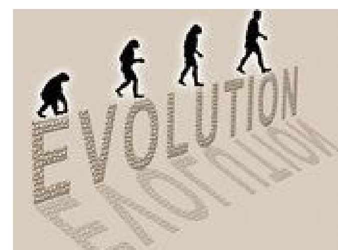
Darwinian evolutionary theory is characterized by faith in the gradualism of biological changes over immense periods of time and in the doctrine of progress. Darwin achieved a scientific revolution by his hypothesis that variations of individuals were, by virtue of their degree of adaptiveness, critical to the biological success of a population existing under continually changing environmental settings. It was the variability of expression of physical and behavioral characters among individuals that enhanced the prospects of the survival of their breeding populations, not a nebulous clustering of individuals around a type specimen that had been the preoccupation of taxonomic typologists seeking the "Ideal Form," or archetype, for each species. Furthermore, for Darwin it was the gradual accumulation of minor variations that brought about descent with modification, not an abrupt saltation over the species line by the innovation of one or many spontaneous variations. Selection, the principle of evolutionary change, was operating at all times, even during the different stages of growth of the individual from the time of conception until death. New species arose from these minor variations that were adaptive and favored by natural selection for survival of those individuals who were endowed with them through inheritance.

Darwin had to encounter the prevailing debate of his century between those who held that the living human "races" could trace their ancestry to a common ancestor (monogenesis) or to multiple ancestors (polygenesis). For a growing number of scientists Darwin's *Origin* rendered irrelevant the polygenesis hypothesis and established a new model for understanding the nature and history of species. Indeed, many biologists accepted Darwinian evolutionary theory because it rejected the concept of multiple creations of human species. Darwin hypothesized that all forms of life were derived from a single original living source, that immense periods of time had elapsed as life continued in myriad forms through geological epochs, that living species were biologically related to extinct species through descent with modification, and that this process was not one of providential tampering but a process involving natural selection and differential fertility. The scientific community came to accept Darwin's view of nature as the nineteenth century drew to its close, and the eventual discovery of fossil human bones and a prehistoric archaeological record meant that mankind's biological history could not be regarded as an exception to his evolutionary biotic model.

Once the idea of man's evolutionary development is accepted, his origins can theoretically be traced back to the origin of life itself – a matter of some two billion years. For practical purposes, however, the point at which to study the beginnings of man is when he began to have the first faint traces of "manness'. How far into the past to dig for such traces is something of a problem. It was first stated by Huxley more than a century ago in a series of questions: " Where, then, must we look for primaeval Man? Was the oldest Homo *sapiens* Pliocene or Miocene, or yet more ancient? In still older strata do the fossilized bones of an Ape more anthropoid, or a Man more pithecoid than any yet known, await the researchers of some unborn paleoanthropologist?"

An ape more anthropoid (manlike); a man more pithecoid (apelike) – that would seem to sum it up with surgical neatness but it does not go back quite far enough. To tell the story more properly, we must look behind man, not probably to monkeys but to apes, manlike apes, and the ultimate *homonins*, that is the archaic men. Whether we descended from these archaic men or whether they met an evolutionary dead-end and replaced by another type of human is another question. In the following pages we shall deal with this topic with reference to Africa and Asia in general and South Asia in particular. Ultimately, the focus will be on Pakistan as we proceed.

II.2. Human Evolution – An African Story



The answers to the questions as to where did early humans come from to colonize South Asia, when did they arrive in the greater Indus Valley, what routes did they take, how did they relate to other

races in diverse regions of the world, how did the cultural and technological developments take place, in what way these developments differed, in what way they showed their similarities, and other questions of similar nature are squarely related to the question of the origins and evolution of man. A rudimentary knowledge of human evolution is, therefore, the first steppingstone in the study of early humans in Pakistan and elsewhere in the Old World. This chapter attempts to provide such a foundation. Anthropological literature is rich in addressing the question of human evolution and some of it is listed in the Bibliography at the end of the book. It is an evolving topic of research and many of the conclusions are obviously tentative at this stage. liest representatives of our own species, Homo *sapiens*.

Human Evolution and the Theory of Natural Selection: Humans like to think that they have always been the center of the universe, but science has proved that this is not so. This planet and its innumerable species are part of an amazingly long, complex, and continuing drama of evolution, in which human beings made a very late entry, and have so far played a very minor role. The earth is about 4.5 billion years old and modern humans appeared on it only some 200,000 years ago. The many advances in the physical sciences in the 20th century have greatly amplified our understanding of the earth's history, while genetic science has unveiled the complex mechanisms that underlay the biological evolution of species. In recent years, advances in DNA analysis have provided important evidence regarding the process of human evolution.

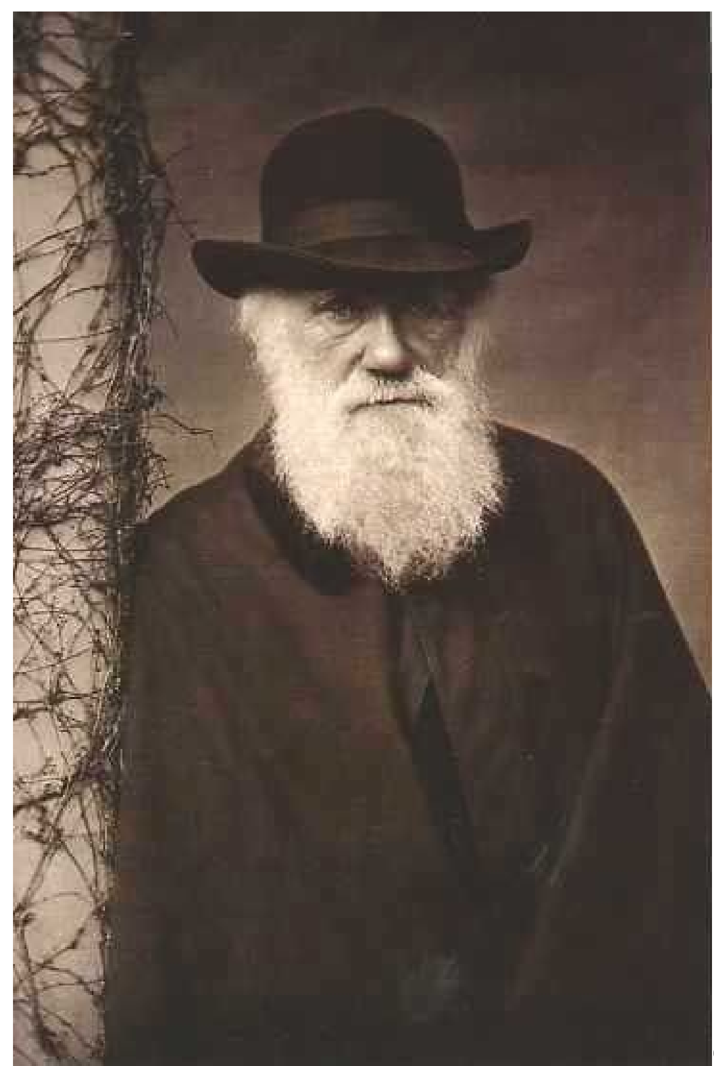
The foundations of biological theories were laid in the 19th century, concept was known in the Muslim world as early as the fourteenth century. Ibn-e-Khaldun, was probaevolutionary although the

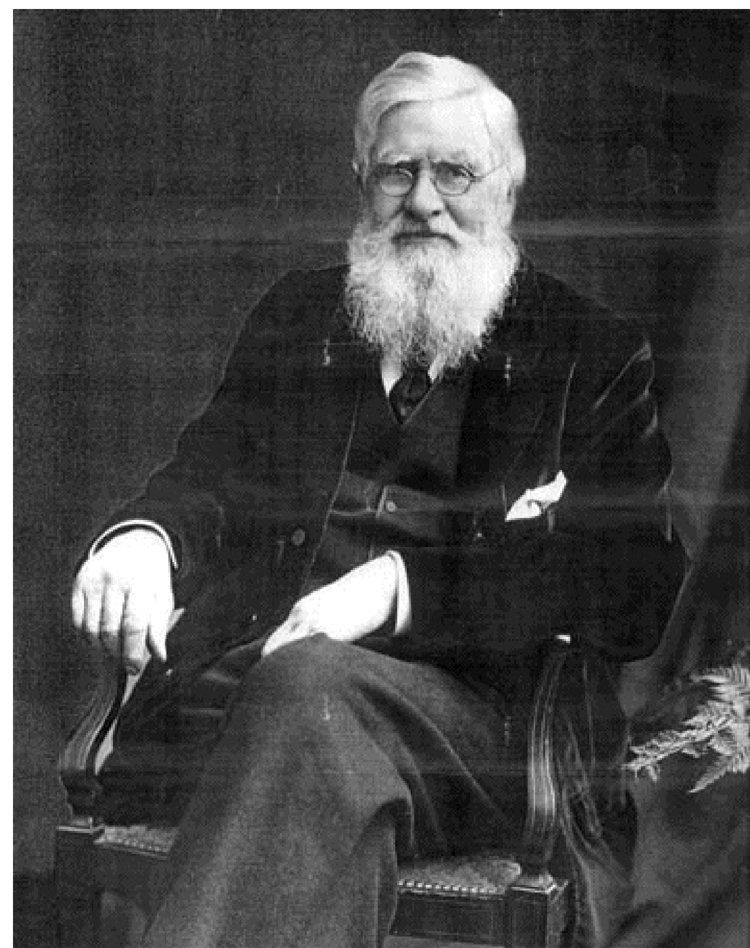


“.........The animal world then widens, its species become numerous, and, in a gradual process of

creation, it finally leads to man, who is able to think and to reflect. The higher stage of man is reached from the world of the monkeys, in which both sagacity and perception are found, but which has not reached the stage of actual reflection and thinking. At this point we come to the first stage of man. This is as far as our observation extends” (*Ibn-e-Khaldun in his Mukaddema, a fourteenth century work on historiography*)

As we follow the history of man, we find the centers of interest swinging from continent to continent. There was a time when the birthplace of man was being thought to be in Asia. There was also time period when “human ancestors” were found in the Siwalik hills of northern Pakistan, another time in the Himalayan foothills of northwestern India. Although it is too soon for final judgement, recently gathered evidence suggests that the earliest hominins emerged in Africa, so did the earliest tool-making species of humans, and perhaps, though by no means so probably, the earbly the first to clearly promulgate theory of biological evolution in its essentials in his *Muqaddimah* (An Introduction to History): “.........The animal world then widens, its species become numerous, and, in a gradual process of creation, it finally leads to man, who is able to think and to reflect. The higher stage of man is reached from the world of the monkeys, in which both sagacity and perception are found, but which has not reached the stage of actual reflection and thinking. At this point we come to the first stage of man. This is as far as our observation extends”
The development of the modern theory of evolution began with the introduction of the concept of natural selection in a joint 1858 paper by Charles Darwin and Alfred Russel Wallace. This theory achieved a wider readership in Darwin's 1859 book, *The Origin of Species*. Darwin and Wallace proposed that evolution in living things occurs because a heritable trait that increases an individual's chance of successfully reproducing will become more common, by inheritance, from one generation to the next, and likewise a heritable trait that decreases an individual's chance of reproducing will become rarer. This work was groundbreaking; it overturned other evolutionary theories, such as that advanced by Jean Baptiste Lamarck. In his *Origin of Species* Darwin did not speak of the evolution of humans; it was the debate between Thomas Huxley and Richard Owenthat that first focused on human evolution. Huxley convincingly illustrated many of the similarities and differences between humans and apes in his 1863 book *Evidence as to Man's Place in Nature*. By the time Darwin published his own book on the subject, *The Descent of Man*, theory of natural selection was already a well-known interpretation of evolution.


Charles Darwin


Alfred Russel Wallace

Theory of Evolution had enormous and unsettling implications, and it is not surprising that many 19th century Europeans found it difficult to accept. It ran counter to the biblical theory of creation according to which nature and humans were created in all their perfection by a divine agency according to a divine plan. It was not easy to accept the idea that reptiles and insects had appeared on the earth long before human beings, or to recognize certain similarities between humans and chimpanzees, or to think of the world as millions of years old. Just as disconcerting was the fact that evolutionary theory suggested that change in nature was continuing, unpredictable, and unstoppable.

In spite of fierce opposition, the theory of evolution rapidly gained ground and it is now accepted universally. Biological data has shown that humans are not only similar to the great apes but, in fact, they are technically themselves great apes. Human evolution concerns the emergence of humans as a distinct species from great apes. It is the subject of a broad scientific inquiry that seeks to understand and describe how and where this change occurred. As will be shown in the followings, human evolution was a long journey, extending over several million years, and there is more than one line of interpretations for this process.

Darwin's original hypothesis has undergone extensive modification and expansion, but the central concepts stand firm. Studies in genetics and molecular biology - fields unknown in Darwin's time - have explained the occurrence of the hereditary variations that are essential to natural selection. The definition of evolution itself has changed: in the modern synthesis, evolution is defined as a change in the frequency of alleles within a population from one generation to the next.

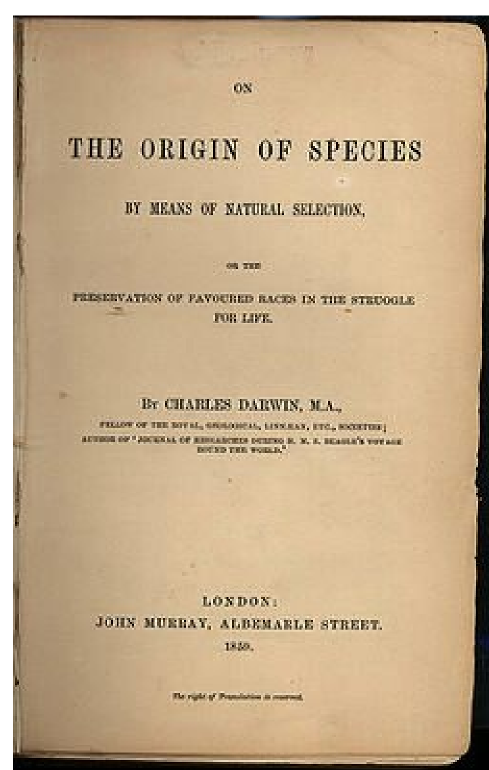
The theory underlying modern synthesis has three major aspects: a common descent of all organism from a single ancestor or ancestral gene pool, a manifestation of novel traits in a lineage, and a mechanism that causes some traits to persist while others perish. According to this schematic, evolution works through *mutation*, which produces genetic variation, which is then acted upon by *drift* (accidental changes in gene frequencies in a population), *gene flow* (the introduction of new genes from other populations), and natural *selection*. Natural selection is the adaptive mechanism of evolution, it works through a reproduction mechanism. The individuals with genes that favor advantageous adaptive traits produce more offspring than those without. Thus, some ‘naturally selected’ genes start to predominate while the frequencies of the disadvantaged genes diminishes and ultimately eliminated.

The breakthroughs in the natural sciences had an immediate and major impact on prehistoric archaeology. Stone tools had been found and reported in earlier decades, but a theoretical perspective within which such finds could be understood was absent. For instance, in 1836, a French customs officer named Jacques Boucher de Perthes had discovered flint tools in the Somme valley He had argued that such tools, in some instances found along with bones of extinct animals, were remains of humans who had lived long before the biblical flood. De Perthes' work was greeted by general skepticism until his finds were authenticated many years later by the geologists Hugh Falconer and Joseph Prestwich, and the archaeologist John Evans.

The terms *species* and *genus* are central to discussions of evolution. A species includes organisms that are similar in physical structure and behavior and which interbreed with each other, or which could do so if they had access to each other. A genus is an assemblage of related species. Take the following example: Canis *familiaris* (the domesticated dog), *Canis lupus* (wolf), and *Canis aureus (*jackal) all belong to the same genus *Canis* - which is mentioned first. The second word is the name of the

species they represent. There are many differences in skin color, facial features, hair color, body build, height, etc. among modern human beings living in different parts of the world, but we all belong to the same species of anatomically modern humans - Homo *sapiens sapiens* (the second *sapiens* refers to our sub-species). *Homo sapiens* is a Latin term, meaning 'thinking man'.

Palaeoanthropologists have used fossil evidence to piece together the fascinating story of the biological and cultural evolution of early humans. This is not an easy task. It is sometimes difficult to identify a species on the basis of incomplete skeletal material and it is not always clear whether these remains are representative of the entire population of an area. Nevertheless, different stages in the


ON

THE ORIGIN OF SPECIES

BY MEANS OF NATURAL SELECTION,

OR THE

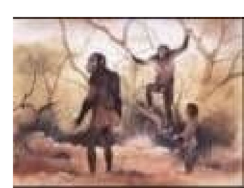
PRESERVATION OF FAVOURED RACES IN THE STRUGGLE FOR LIFE.

BY CHARLES DARWIN, M.A.,

LONDON:
JOHN MURRAY, ALBEMARLE STREET.
1859.

The original edition (1859) of Darwins's *The Origins of Species*

process of human evolution can be identified, as can the implications of crucial biological markers such as increase in cranial capacity (brain size), changes in pelvic structure and the beginnings of bipedalism (walking erect on two legs), and the modification of dental structure due to changing food habits. Some important aspects of the cultural evolution of early humans include the making of stone tools, the emergence of some kind



how those predecessors moved around, held tools, and how the size of their brains changed over a long period of time. Archeological evidence refers to the things earlier people made and the places where scientists find them. By studying this type of evidence, archeologists can understand how early humans made and used tools and lived in their environments.

An enormous amount of scientific investigation since the mid-19th century has converted early ideas about evolution proposed first by Ibn Khaldun and later by Darwin and others into a strong and well-supported theory. Today, evolution is an extremely active field of research, with an abundance of new

discoveries that are continually increasing our understanding of how evolution occurs. Many of the most important advances over the past century relate to connecting links - intermediate between and along various branches of the human family tree - that are derived from human and primate fossil record. These linking fossils occur in geological deposits of intermediate age and they document the time and rate at which primate and human evolution occurred. Archaeologists have unearthed thousands of fossil specimens representing members of the human family. Most of these specimens have been well dated, often by means of radiometric techniques. They reveal a well-branched tree, parts of which trace a general evolutionary sequence leading from ape-like forms to modem humans. However, gaps still remain and these are the topics of intense debate.

Genetics is presently playing a leading role in defining the process of human evolution on molecular level, in mapping the ancient human populations across the Old World, and in determining the time line for major events in the evolutionary journey of man. There are several branches of genetics that touch upon the question of human evolution, one of them being population genetics. For our purpose, population genetics addresses three basic but interrelated issues, the issues with which prehistorians are normally concerned: the origins of humans and the molecular processes through which this evolution took place, the localization of the center or centers of human population where major evolutionary processes took place, and the mapping the routes of the human population dispersal and allocating the time lines.

Primates, Apes, Hominids, Hominins, Homo, and Humans: The early Man, the unique animal with whose subsequent achievements this book



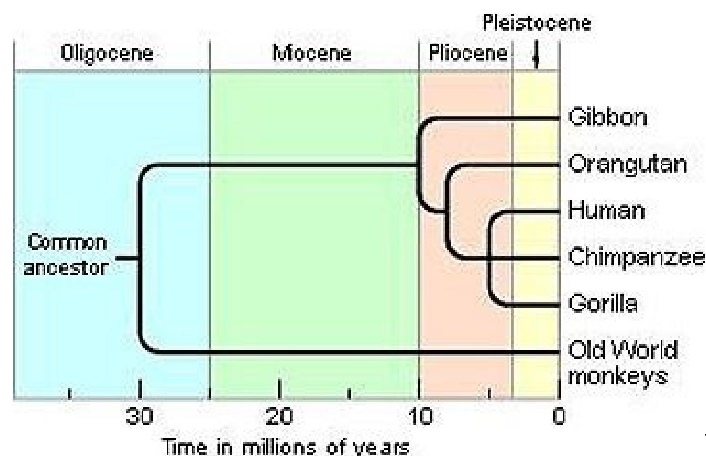
Thomas Huxley

of social organization, the beginnings of language, and the capacity for symbolic thought.

The Study of Human Evolution: The study of human evolution is the subject of Paleoanthropology, which is a subfield of anthropology, the study of human culture, society, and biology. The field involves an understanding of the similarities and differences between humans and other species in their genes, body form, physiology, and behavior. Early human fossils and archeological remains offer the most important clues about this ancient past. These remains include bones, tools and any other evidence (such as footprints, evidence of hearths, or butchery marks on animal bones) left by earlier people. Usually, the remains were buried and preserved naturally. They are then found either on the surface (exposed by rain, rivers, and wind erosion) or by digging in the ground. By studying fossilized bones, scientists learn about the physical appearance of earlier humans and how it changed. Bone size, shape, and markings left by muscles tell us is concerned, belongs to the order of the *Primates*, which he shares with lemurs, monkeys and apes. To follow his emergence, then, we should be following the main line of primate evolution up to the super-family of the *Hominidae*, to which man is assigned, together with his nearest surviving kins, the chimpanzee, gorilla, orangutan and gibbon. Analysis of many proteins and genes has shown that humans are genetically similar to chimpanzees and gorillas and less similar to orangutans and other primates.

The evolution of primates and their subfamilies shows some general trends. Our knowledge of these general trends derives from a scatter of fossil finds from many regions of the Old World. They are already considerable in number and rapidly increasing, yet they are still haphazard, greatly affected

by the varying intensity of research in different areas - and in many instances extremely fragmentary. Yet in spite of all shortcomings, and in spite of one or two major issues still in dispute, a coherent picture is beginning to emerge. Africa comes in focus again and again in this search for the origins of man.



Family tree of primates, showing the relationship of man with the Great Apes

On commonsense grounds, it seems obvious that we as humans are different from apes such as the African chimpanzee and gorilla and the Asian orangutan. For example, we have much larger brains; our backs are straighter; because of our upright posture, we walk confidently on two legs in an upright manner; our feet are poor at grasping although our hands are very proficient at manipulating all manner of objects; our faces are short and do not project; and we are comparatively hairless. Additionally, we depend upon tools for our survival, use fire, and have language. Until recently, these differences seemed robust and longstanding, and thus we defined ourselves as belong to the family *Hominidae*, and the apes as members of the family *Pongidae* - hence the terms *hominids* for ourselves and our ancestors, and *pongids* for the extant apes and their ancestors.
Genetic studies, however, show a very different grouping: genetically, we are much closer to the chimpanzee and gorilla than either is to the Asian orangutan. (In fact, we share 98.6% of our DNA with the chimpanzee, and only a little less with the gorilla). The implication - increasingly supported by fossil evidence - is that the ancestor of the orangutan branched off before the last common ancestor (LCA) of gorillas, chimpanzees, and humans (see the figure below). The family of hominids therefore has to include us and our African cousins, the chimpanzee and gorilla alone but not our Asian relative orangutan. Apart from this correction, we need some way of distinguishing our ancestors from those of the gorilla and chimpanzee, and so we now use the term "*hominin*" to denote the grouping within the family of hominids that belongs to our lineage.

This understandably can cause some confusion amongst those who think "hominin" is a misprint, or haven't realized that the term "hominid" now means different things to different people. In the literature before around 1990, "hominid" meant our own lineage, and not that involving chimpanzees, gorillas, and orangutans. Nowadays, it is supposed to mean ourselves, chimpanzees, and gorillas as members of one family that is distinct from the family of Asian apes. “Hominin”, on the other hand, is recommended to denote specifically our our ancestry, hence the increasing use of the term *hominin* in more recent literature.

Homo is a genus of Hominin, the only living species being *Homo sapiens*, or humans. We define *Homo*, just as we define hominin and hominid, in terms of his anatomical features.The genus *Homo* is characterized by an upright posture, large brains, high intelligence, and hairlessness. Some of the

most famous members of the genus are *Homo habilis* (lived 2.5 - 1.6 million years ago), *Homo erectus* (2 million - 200,000 years ago), *Homo heidelbergensis* (600,000 to 250,000 years ago), *Homo neanderthalis* (130,000 - 30,000 years ago), *Homo floresiensis* (95,000 to 13,000 years ago) and *Homo sapiens* (200,000 years ago to present). Other, less-often-mentioned species include *Homo helmei, Homo njarasensis, Homo rudolfensis, Homo atlanthropus, Homo rhodesiensis, Homo georgicus, Homo antecessor*, and *Homo cepranensis*, for a total of 14 currently known species.

The emergence of *Homo erectus* (named for his fully erect posture) was particularly important step in the evolutionary process leading to modern man. After appearing in East Africa around 2 million years ago, this species seems to have spread to various parts of Africa, Asia, and Europe. From about 130,000 years ago, there is evidence of *Homo sapiens neanderthalis* (Neanderthals) in various parts of western and central Asia and in Europe. Whether the Neanderthals evolved into *Homo sapiens* or whether they became extinct remains a mystery.
Apart from Africa and Europe, hominid remains have also been found in various parts of Asia. Remains of *Homo erectus* in Java have been dated between 1 to 2 million years ago and were associated with animal bones of many species but no stone tools. Remains of *Homo erectus* discovered in the Zhoukoudian caves 50 km south-west of Beijing are dated between 0.58 to 0.25million years ago. This site also yielded over 20,000 stone tools and bones of 96 mammalian species.

Confucius is reported to have said: "The first step in the path of wisdom is to call things by their right names". Well, not-withstanding this advice and to the annoyance of paleoanthropologist and other exact scientists (and the possible displeasure of Confucius), most of the prehistorians and lay writers do not make much fuss about hominids and hominins unless they have to. They use these terms interchangeably or simply designate them as 'early humans' or "humans' ancestors". Conversely, Homo *sapiens* are simply 'modern humans'. For our purpose in this book, we are not adverse to the use of *Hominids* and *Hominins* except that we may sometimes inadvertently use these terms interchangeably. Of course, we do not mind to use the terms like human ancestors, early humans, etc. to denote more or less the same entity.

The First Ancestors of Man: It is now believed that the first ancestor of humankind had appeared in Africa - some 4 million years ago. It has been named *Australopithecus.* Australopithecus is believed to be remarkably human from the waist down and had become fully adapted for moving about on the open savanna on its hind legs in the distinct human manner. In other aspects, however, *Australopethicus* was not human, not even close. Nevertheless, the *australopithecines* are thought to be immediate ancestors of the genus *Homo*, the group to which modern humans belong.

All australopithecines before 3 million years ago may have belonged to a single evolving lineage, but sometime between 3–2.5 million years ago, branching produced at least two distinct lineages. The first lineage was marked by a modest increase in brain size and by a large increase in the size of the cheek teeth. The members of this lineage are commonly assigned to the genus *Paranthropus*, and they are referred to colloquially as the "robust" australopithecines, although they were robust only in the power of their chewing apparatus. They apparently became extinct around 1.2 million years ago.

In contrast, the second lineage was marked by a significant increase in brain size and by a reduction in the size of the cheek teeth. It was probably omnivorous, and it is the obvious choice for the ancestor of later humans in the genus *Homo*. There is the problem, however, that fossils of the second

lineage are well-known only after 2 million years ago, and it remains possible that the earliest members did not anticipate later humans in either brainsize increase or dental reduction. This may be im90 plied by a recently discovered skull from the Middle Awash region of Ethiopia. It has been dated to 2.5 million years ago, and it shows no features that would preclude a relationship to Homo. The skull has been assigned to a new species of australopithecine (Australopithecus *garhi*) that could lie near the ancestry of Homo, and the case would be especially strong if the new species produced the stonetool-marked animal bones recovered from like-aged deposits nearby.

These half-ape-half-human creatures were a diverse group, but overall, stone tools were absent at sites containing their fossils, brain sizes were chimp-like, cheek teeth and supporting masticatory structures were enormous, numerous primitive traits were retained in all parts of the body, including the skull, bodies were small, there was strong sexual dimorphism in body size, and hind limbs were small relative to forelimbs (4). Although they were bipedal to some degree, they were still probably competent at moving in trees. Wood (5) suggests that they were "facultative bipeds", that is, they could be bipedal when needed, in contrast to "obligate bipeds" such as *Homo ergaster* and ourselves, who have few other effective options for moving around.

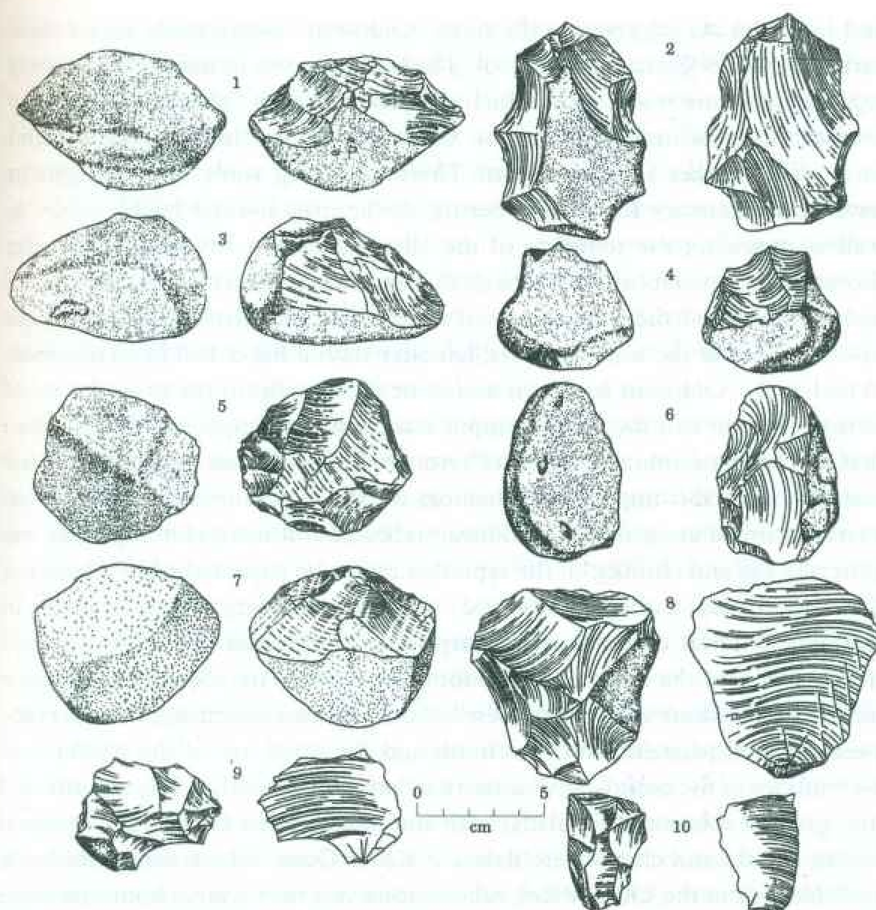


Figure 2.3. A selection of the 2.6-Ma stone tools from Kada Gona, Ethiopia. Drawings of artefacts (cores and flakes) excavated from EG10 and EG12. (1) unifacial chopper, EG10; (2) discoid, EG10; (3) unifacial side chopper, EG12; (4) unifacial end chopper, EG12; (5) partial (irregular discoid), EG12; (6) unifacial side chopper, EG10; (7) unifacial side chopper, EG12; (8–10) whole flakes, EG10. *Source:* Reprinted from Semaw 2000, Figure 6.

1 and 2, and Kromdraai B, and are from between 1.5 and 2.0 Ma (Kuman 1998). In North Africa, the oldest stone tools are those from Ain Hanech, ca. 1.8 Ma (Sahnouni et al. 2002; Sahnouni 2006). These are at present the first evidence of hominins (not necessarily *Homo*) in this part of Africa, as they are not recorded in the long Pliocene section at Casablanca in Morocco before the late Early Pleistocene (Raynal et al. 2001).

These early lithic assemblages are normally called the Oldowan, after the German name for Olduvai (as the country that is now Tanzania was German Tangyanika before 1919). Although there have been suggestions that there was a "pre-Oldowan" phase before 2.0 Ma that was less sophisticated than the Oldowan at Olduvai and Koobi Fora, the recent discoveries at Gona

Figure 2**A selection of the 2.6 million years old stone tools from** wings of artefacts (cores and flakes) excavated from EGIO and EGI2. (1) unifacial chopper,
Kada Goan, Ethiopia

E GIO; (2) discoid, EGIO; (3) unifacial side chopper, EGI2; (4) unifacial end chopper, EGI2; *(s)* partial (irregular discoid), EGI2;
unifacial side chopper, EGI2; (8-10) whole

Semaw 2000, Figur

Australopithecines are currently of tangential
e 6.
(6) unifacial side chopper, EGIO; (7)
flakes, EGIO. *Source:* Reprinted from

relevance to the early prehistory of Asia, as none has yet been found in Asia. It is, however, worth keeping an open mind on this matter: first, the absence of a desert barrier between Northeast Africa

first e vidence of hom in ins (not necessarily *Homo)* in this part of Africa, as they and Southwest Asia in the Late Pliocene meant that
are not recorded in the long Pliocene section at Casablanca in Morocco before

faunal movements out of and into Africa were easier
the late Early Pleistocene (Raynal et al. 200 I).

than in more recent times; second, the Pliocene faunal record of Asia is extremely poor and thus it cannot yet be demonstrated that australopithecines

was a "pre-Oldowan" phase before 2.0 Ma that was less sophisticated than the Oldowan at Olduvai and Koobi Fora, the recent discoveries at Gona

were absent from this region; and third, as seen below, it is most unlikely that the full range of australopithecines has yet been established in Africa, given the number of new taxa found since 1994 (3).

The Appearance of Early Homo: Physical anthropologists agree that the genus *Homo* evolved from one of the species of *Australopithecus*. Discoveries in the 1990s from central Kenya and from the Hadar area of Ethiopia suggest that early Homo was present in East Africa by 2.4-2.3 million years ago. There may, in fact, have been more than one species of Homo living in Africa during this time. So, more generally, we refer to them all as ‘early Homonins’. The species Homo *habilis* refers particularly to these early Homonin fossils.

During 1960s Leaky and his wife, Mary, discovered several hominin remains at Olduvai Gorge, East Africa, that dated *ca.* 1.8 million years ago. This creature was much closer to humans than *Australopethicus*, from which *Homo Habilis* is supposed to have been derived. In its appearance and morphology, Homo *habilis* was short and had disproportionately long arms compared to modern humans. Homo *habilis* had a cranial capacity slightly less than half of the size of modern humans, thus having relatively small brains, and despite the ape-like morphology of the body, was capable of walking on two feet.

It was also the first species in which sexual dimorphism (difference in body size) was reduced to the modern human level, and this may imply that it was the first to enjoy a typically human form of social

organization involving sharing and cooperation between the sexes. It was the first human species to colonize truly arid, highly seasonal African environments, and sometime before 1 million years ago, it may have become the first human species to spread to Eurasia.

The original definition of Homo *habilis* was based entirely upon morphological criteria, although its inferred ability to make stone tools influenced the decision to name it *"habilis"*, or the ‘handy-man’. The shapes of the pelvic and leg bones suggest that these early *Homo* were not part-time climbers like *Australopithecus* but walked and ran on long legs, as modem humans do. Just as *Australopithecus* showed a complex of ape-like, human-like, and intermediate features, so was early *Homo* intermediate between modern humans and Austrolapithecus. Homo *habilis*, with its larger brain than *Australopithecus*, was a maker of stone tools and the earliest stone tools are of virtually the same age as the earliest fossils of Homo. The jury is, however, out on this point, some paleoanthropologists assigning the first tool-making capability to earlier form, such as autralopithecus (3).

A New Kind of Hominin: In the last few decades, discoveries from East Africa of firmly dated finds have established the clear evidence for the presence of a new kind of Homonin to which a variety of taxonomic names were suggested. Some of these names still find currency in undergraduate textbooks on biology and anthropology. Such taxonomic splitting was quite common in the early years of paleoanthropology but in recent years most of the fossils that were given these varied names are now placed in the species Homo *erectus*. Some researchers saw several anatomical differences between African hominins and their Asian cousins (the latter recognized by almost everybody as Homo *erectus*). Thus, they placed the African fossils into a separate species, one they call Homo *ergaster*. While there are some anatomical differences between the African specimens and those from Asia, they are all clearly closely related and quite possibly represent geographical varieties of a single species. On this account, Homo *ergaster* is sometimes designated as Homo *erectus* ergaster.

Homo *e r g a s t e r (o r* Homo *erectus ergaster)* i s supposed to be living throughout eastern and southern Africa between 1.8 to 1.4 million years ago. The species name originates from the Greek ergaster meaning "workm a n " . T h i s name was chosen due to the discovery of various tools such as hand-axes and cleavers near the skeletal remains of Homo *ergaster*. The use of advanced (rather than simple) tools was unique to this species; Homo *ergaster* tool use belongs to the Acheulean industry see below), which begins to appear in 1.6 million years ago. Charred animal bones in fossil deposits and traces of camps suggest that the species made creative use of fire. A complete Homo *ergaster* skeleton was discovered at Lake Turkana, Kenya in 1984 (see above).

According to Aiello and Wells (6), this hominin is distinguished by "a complex of skeletal and dental features reflecting a lifestyle that was more similar to that of modern humans than that inferred for earlier and contemporaneouss hominids in Africa. These skeletal and dental features include a larger body mass, more human-like body proportions, relatively long legs, obligate bipedalism coupled with a limited facility for climbing, relatively small teeth and jaws, suggesting a major dietary change, and a tendency towards an extended period of growth and development".

Although *Homo ergaster* would undoubtedly have made use of a variety of other food resources such as invertebrates (e.g., termites) or nuts, seeds, honey, etc., increased reliance on mammalian meat and fat would have altered the basic balance between dietary quality and dietary bulk. The diet of

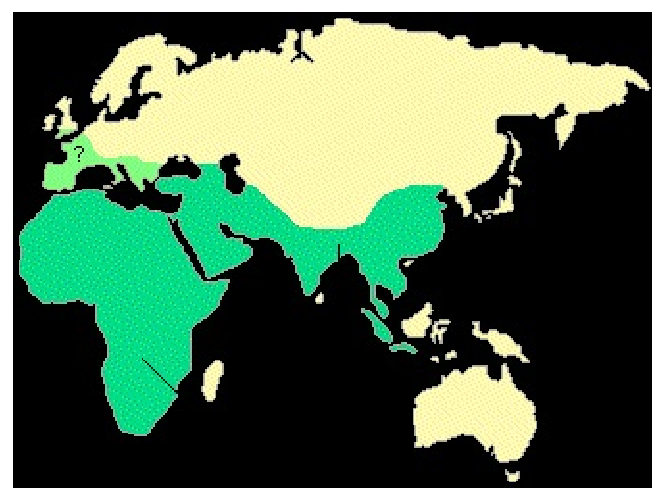


A 1.75-million-year-old skull from Kenya, believed to be an example of Homo *ergaster*

Homo *ergaster* was therefore not an australopithecine diet with added meat, but involved a change in the proportions and type of both animal and vegetable foods.

Intriguingly, there is an anatomical discontinuity between Homo *ergaster* and any other preexisting Hominin species in Africa and is therefore termed "a hominin without an ancestor." This absence of a clear ancestry has given rise to the suspicion that Homo *ergaster* may have been an implant from Asia. Dennell (7) is the most vocal proponent of such a possibility.

Homo *erectus* and the Contemporaries: The period between I.9 and I.5 million years ago is widely regarded as a critical period in our evolution: for the first time, humans expanded widely out of Africa into other areas of the Old World. These widely dispersed hominins were quite different both anatomically and behaviorally from their homebound ancestors. They were much larger, were more committed to a completely terrestrial habitat, used more elaborate stone tools, and were capable of adapting culturally to the demands of the new environments into which they spread.



Distribution of Homo *erectus* in the early Pleistocene (green)

Anthropologists continue to debate how to classify biological variations among the different geographical groups of these highly successful hominins. Moreover, discoveries of hominin fossils and artifacts are ongoing. New fossil finds from Europe and Caucasus as well as the re-dating of those from Southeast Asia are forcing a major reevaluation of exactly which kind of hominin was the first to leave Africa. The species for which there is the most evidence is Homo *erectus*. Furthermore, this is the one group that most paleoanthropologists have recognized for decades and still agree on. This species is also important to the colonization of South Asia of which Pakistan is a part. In fact, the first colonization of Pakistan may be the story of the expansion of Homo *erectus* into South Asia.

Homo *erectus* was probably the first early human species to fit squarely into the category of a hunter-gatherer society. Anthropologists such as Richard Leakey believe that Homo *erectus* was socially closer to modern humans than the more primitive species before it. Homo *erectus* was a large brained specie, with adult brains ranging from 900 to 1200 cc, which falls within the range of modern humans. The *Homo erectus* brain is, however, configured somewhat differently than our own. The increased cranial capacity generally coincides with the more sophisticated tool technology occasionally found with the specie's remains. It is believed that Homo *erectus* is the ancestor of Homo *sapiens* although there are some who believe that Homo *erectus* is not the direct ancestor of modern Homo *sapiens*.

The populations of Homo *erectus* were widespread between about 1.8 million years and 400,000 years ago, living in Africa, Europe, China, and probably in South and West Asia. Having larger brains than his ancestors, Homo *erectus* became better able to adapt to different situations through the medium of technology. This is reflected by better-made tools, a greater variety of tool types, regional diversification of tool kits, and use of fire. It is theorized that Homo *erectus* first used the tools of Oldowan style (tools made of stone pebbles by chipping one end and creating a sharp edge) but later progressed to the Acheulean handaxes (a tool pointed at one end with a cutting edge all around) that remained essentially unchanged until about 500,000 to 800,000 years ago, depending on the region. They were more efficient for cutting, chopping and scraping, and they were more standardized in form than the Oldowan tools.

Massive ridges over the eyes gave this early hominin a somewhat simian, "beetie-browed" appearance. Homo *erectus* also possessed a sloping forehead and a receding chin. Powerful jaws with large teeth, protruding mouth, and massive neck muscles added to the generally rugged appearance. The limbs of this pre-sapiens human were highly developed and structurally close to those of modern

humans. Anatomical studies of Homo *erectus'* legs and feet bones indicate that this hominin walked and ran like modern humans.

Fossil specimens indicate that the sexual dimorphism between males and females was considerably reduced, which means that adult Homo *erectus* females were considerably larger proportionately as well as absolutely than females of Homo *habilis*. Their chest proportions were also very different, with a barrel-shaped profile instead of the pear-shaped one of australopithecines. The most remarkable differences from earlier African hominins are shown by its limb proportions. "Here at last", suggested Tattersall (8), "we have early hominids who were at home in the open savanna".

Wheeler (9) has suggested that early Homo *erectus* was probably efficient at sweating and cooling, which would have been highly advantageous in arid and open grasslands. These advantages would have allowed it to occupy a larger home range, and forage over larger distances, than its predecessors. It may also have been the first hominin capable of sustained endurance running, a skill that would have been very advantageous in enabling it to compete with other scavengers for scattered and ephemeral resources. It has also been argued that a large-brained hominin such as Homo *erectus* would have been more successful in acquiring meat than its smaller-brained predecessors; or rather, as every evolutionary advantage comes at a cost, it would have had to consume larger amounts of animal protein in order to maintain its energetically expensive brain (ours, for example, requires roughly a third of what we eat, even though it comprises <5% of our body weight).

We mentioned that there is considerable variation in different regional populations of hominins broadly defined as Homo *erectus*. New discoveries are showing even more dramatic variation, suggesting that some of these hominins may not fit closely at all with this general adaptive pattern. One such group, belonging to the same timeline, is that discovered at Dmanisi in Georgia. The Dmanisi hominins are hard to assimilate within a simple model of African origin and Asian dispersal by Homo *erectus*.

It has been proposed that the Dminisi fossils preserve several affinities with Homo *habilis* and can be considered as one of their descendants, foretelling the emergence of Homo *erectus*. Since It is close to the roots of the Homo branch, its presence in Asia indicates an early hominid diffusion from Africa towards Eurasia, between 2 and 1.8 million years ago, by the Levantine corridor (10). This means that hominins could have dispersed from Africa much earlier than Homo *erectus*. Since Homo erectus is believed to be the first hominin species that expanded over a large geographic area and since Homo *habilis* is generally believed to be incapable of such a feat, difficulties remain.

Rigfhtmire et al (11), on the other hand, propose that the Dmanisi crania are most appropriately classified as Homo *erectus* s.l., but are also the most primitive types yet found, and suggest that the term Homo *erectus georgicus* is available to allow differentiation from the East African populations of Homo *erectus ergaster* and the Javan ones of Homo *erectus erectus*. The most provocative part of their analysis is their suggestion that the Dmanisi population may be ancestral to early Homo *erectus ergaster* in East Africa; as they state: "Dating does not presently rule out the possibility that Homo erectus originated in Eurasia and that some groups then returned to Africa, where they evolved towards Homo *erectus ergaster*" (11). The implications of the suggestions that hominins left Africa before 1.8 million years ago and that Late Pliocene dispersals of hominids may have been both out of and into Africa, has also been suggested by Dennell (3).

It appears that by 1.4 million years years ago, most of the Old World was already colonized by Homo

erectus. Compared to Africa, Europe, West Africa, and the Southeast Asia, the Far East is much less known. But artifact types aside, the available information suggests no essential behavioral or ecological difference between contemporaneous East Asian and West Asian populations. The famous "Peking Man" cave of Zhoukoudian Locality 1, northern China, dated to 600,000 – 400,000 years ago, has provided numerous large mammal bones that were probably introduced by people, and they provide no reason to suppose the Locality 1 people hunted or scavenged less proficiently than their Western contemporaries.

The evidence from Pakistan, or from South Asia in general, is not clear. A few stone artifacts have been discovered in the Soan Valley (Pothwar) in Pakistan which have been dated to *ca.* 2 million years ago. This discovery is somewhat controversial. If true, it clearly indicates the presence of human ancestors in this part of the world during the same temporal horizon as that of Dminisi in Georgia or the re-dated finds in Java, even earlier. Who were the authors of these stone tools? Most likely Homo *erectus,* but of what type?

The Pleistocene world forced many small populations into geographical isolation. Most of these regional populations no doubt died out. Some, however, did evolve, and their descendants are likely to represent a major part of the later hominin fossil record. In Africa, Homo *heidelbergensis* is hypothesized to have evolved into modern Homo *sapiens.* In Europe, Homo Heidelbergensis probably evolved into Neanderthals. Right now, there is no consensus on the status or likely fate of the enigmatic Chinese Middle Pleistocene hominins. The presence of Homo *heidelbergensis* is known in India through the fossil find at Hathrona. Was the Middle Pleistocene population in Pakistan, especially that of the Pothwar Plateau, related to this Indian population? or was it more a part of the Homo *heidelbergensis* branch of central Asia that later evolved into Neanderthals? Keeping in view the geography of the region, the latter possibility seems to be more logical.

The Use of Fire: The use of fire, for warming the living space and for cooking (largely burning of meat) was a crucial step in the evolutionary struggle of man. Locality 1 at Zhoukoudian caves in northern China, mentioned above, contains what may be the oldest firm evidence for human mastery of fire. The claim is disputed, because chemical analysis has failed to identify mineral ash in the deposits, but burned bones are relatively common, and they cluster stratigraphically with quartzite artifacts.

Arguably, people could not have colonized northern China and other parts of temperate Eurasia without fire for warmth and food preparation. However, if an incontestable hearth is required for proof, mastery of fire is documented only after 200,000 years ago, at African, west Asian, and European cave sites. In some caves, the hearths occur in deeply stratified stacks that suggest people could kindle fire at will and that may also imply continuity in the social use of space. The value of determining when people first mastered fire cannot be exaggerated, for it could help to resolve other key issues like the possibility that Oldowan artifact-andbone clusters represent true camp sites, the probability that Oldowan or later people could profit from animal bones without flesh, or the likelihood that human morphological change 1.8 to 1.7 million years ago was linked to an increased reliance on subterranean plant foods.

Archaic Homo *sapiens*: This brings us to the emergence of anatomically "modern" humans, the one we call Homo *sapiens.* With the emergence of modern man begins our history; we therefore treat him with some dignity by devoting a separate chapter to his origin (Chapter II.4). Here we want to make a

few remarks on a nebulous group of hominins which were advanced enough to be called ‘*sapiens*’ but primitive enough to be named ‘*archaic*’, thus *archaic Homo sapiens*. Most of the pertinent fossils known at the time came from European sites. The skulls from these sites had hunman-sized braincases, but their cranial morphology was certainly not modern. These people were admitted to membership in our own species because of their almost modern-seized brains but set off as ‘archaic’ because of their primitive-looking cranial morphology.

From 1980s on, however, certain theoretical considerations led to calls for recognition of more hominin species and encouraged paleoanthropologists to make ever more and finer taxonomic distinctions within the genus Homo. Tattersall (12) particularly criticized the concept of ‘archaic homo sapiens’ a category that he saw as taxonomically meaningless and without parallels in other domains of biology. He suggested resurrecting the taxon Homo *heidelbergensis* for earlier European Homo, as distinguished from the later Neanderthals.

This matter is still pending but a growing consensus seems to be emerging in recent years. Beginning perhaps as early as 800,000 years ago to about 200,000 years ago, the fossils from Africa and Europe are placed within Homo *heidelbergensis*. What is more, some Asian specimens possibly represent a regional variant of Homo *heidelbergensis*, an example being the partial cranium from Hathrona, India, which has been dated to ca. 300,000 years ago. As far as the students of prehistory are concerned, distinguishing the fossils that lie somewhere between Homo *erectus* and Homo *sapiens*, or between 400,000 years ago and 50,000 years ago, as separate species would seem to make for greater taxonomic precision. But imaginary precision is not a satisfactory substitute for messy biological reality and adds nothing to the story of Man.

The fossil record shows that following the initial dispersal of people from Africa 1.5 million years ago or even earlier, populations in Africa, Europe, South Asia and the Far East diverged morphologically via natural selection and gene drift. The trend was particularly clear by 500,000 - 400,000 years ago, and from this time onwards, there were several human lineages inhabiting Africa and Eurasia. These may always have been able to exchange genes, but distance and small population size probably limited gene flow.

Most of the hominins falling in this category lived during the Pleistocene epoch, generally known as the Ice Age. The middle Pleistocene, the time period from *ca*. 600,000 years ago to 150,000 years ago is the most significant in this regards. Some of the later archaic humans, especially the Neanderthals, lived well into the Late Pleistocene period. Like their Homo *erectus* predecessors, archaic Homo *sapiens* were widely distributed in the Old


Neandertaler- an archaic Homo sapiens. The picture was shot in the Neandertal Museum in Mettmann, Germany

World. For the first time Europe became more permanently and densely occupied, as Middle Pleistocene was approaching. The archaic Homo sapiens of the Middle Pleistocene generally succeeded Homo *erectus*. Still, in some areas - especially in Southeast Asia - there apparently was a long period of coexistence, lasting 300,000 years or longer. The archaic Homo *sapiens* were seemingly well adapted to different environmental stresses, as evidenced by the wide distribution of their tool and fossil remains. Their brains were larger than those of Homo *erectus*, and were comparable in size to those of modern humans. As stated before, the archaic group includes the classic Neanderthals, which were the first ancient Homo *sapiens* to be recognized as such, at least in the Near East and Europe. Archaic Homo *sapiens* are also known from Africa and East Asia, they lived between 300,000 and 100,000 years ago, depending on the region under consideration.

We know that archaic Homo *sapiens* were a diverse group dispersed over three continents. Archaic fossils from Africa and Europe resemble each other more than they do with the hominins from Asia. The mix of some ancestral characteristics retained from Homo *erectus* - with more derived features gives the African and European fossils a distinctive look. The situation in Asia is not so tidy. To some researchers, the remains seem more modern than do contemporary fossils from Europe or Africa. This observation explains why Chinese paleoanthropologists and some American colleagues conclude that the Inniushan remains are early members of Homo sapiens.

The Neanderthals are by far the best-studied extinct hominins, with a rich fossil record, sampling hundreds of individuals, heavily biased towards the western part of their range, i.e. western Europe. The northern, eastern and southern limits to their distribution are poorly documented, again because of an imbalance in research intensity. A juvenile from Teshik-Tash, Uzbekistan, is the easternmost one known, at roughly 1,300 and 2,000 miles from its nearest fossil neighbors, Shanidar in Iraq and Koba in the Black Sea area, respectively. The southern limit of their distribution is unknown, and may have extended over the whole of Arabia and the Indian subcontinent - we cannot be certain until these regions produce the necessary fossil evidence. The Neanderthals are sometimes considered a dead-end specie but sometimes one of the ancestors of modern man. In its latter manifestation, the Neanderthal may be considered a transitional hominins and can be categorized under *archaic* homo *sapiens*.

The Neanderthals disappear from the fossil record after about 40,000 years ago. Possible scenarios are: 1) Neanderthals were a separate species from modern humans, and became extinct (due to climate change or interaction with humans) and were replaced by *Homo sapiens* moving into its habitat beginning around 80,000 years ago. Competition from *Homo sapiens* probably contributed to Neanderthal extinction. 2) Neanderthals were a contemporary subspecies that bred with *Homo sapiens* and disappeared through absorption. We shall not dwell any more on Neanderthal for their marginality in the study of the Stone Age of South Asia in general and Pakistan in particular.

Outside of Europe and western Asia, a number of skulls have been found in Africa, China, and Java, which are roughly contemporary with the Neanderthals, or at least the earliest ones. They differ from the Neanderthals primarily in their lack of midfacial projection and the absence of such massive muscle attachments on the back of their skulls. Thus, the Neanderthals represent an extreme form of archaic *sapiens*. Elsewhere, the archaics look like robust versions of the early modern populations that lived in the same regions or, if one looks backward, somewhat less primitive versions of the Homo *erectus* populations that preceded them. As the first hominins to possess brains of modern size, it is not surprising to find that the cultural capabilities of archaic Homo *sapiens* were significantly improved over those of earlier hominins. Such a brain made possible an advanced technology as well as conceptual thought of considerable sophistication. In short, the archaic Homo *sapiens* were fully "sapient" (wise) species of human being, relatively successful in surviving and thriving even in environments that would seem to us impossibly cold and hostile.

Climate Change and Early Hominin Evolution 2.5-1.6 million years ago: Vrba (13) and Dennell (3) independently proposed that the developments relating to the emergence of our genus *Homo*, the making of stone tools, and the evidence for the consumption of meat and marrow all resulted from increasingly more arid and seasonally distinct conditions after 2.5 million years ago. Vbra suggested that these climatic changes would have favored hominins that could access harder and coarser foods, and widen their resource base by acquiring animal protein. Hominins would also have faced more complex, difficult, and unstable situations: complex because some resources (e.g., plants) would have become more seasonally distinct and resource scheduling thus became more complicated; difficult because as the climate became drier, resources would have been more dispersed, and thus harder to locate and obtain; and unstable because of numerous minor oscillations in temperature and precipitation.

Grasslands would also have expanded, along with a range of dangerous predators, and those too would have made life more difficult for early hominins. Those that could develop new strategies, such as using stone tools, processing more information by acquiring larger brains, eating larger amounts of meat, or developing larger cheek-teeth that could process harder foods, would have been advantaged. Thus the reason our genus *Homo* as well as stone tool-making and carnivory, all originated around or shortly after 2.5 million years ago, and was primarily, in their view, the change in climate brought about by the onset of northern hemisphere glaciation. Furthermore, Vrba argued that the hominin lineage was not the only one to experience rapid change at this time. Bovids also show an increase in hypsodonty (i.e., high-crowned teeth that are better adapted to grazing on tough, silicaceous grasses), and even rodents developed tougher teeth, and longer hind-legs that enabled those that hop to forage over greater distances.

Vbra's model was undoubtedly one of the most comprehensive and powerful ways of explaining a wide range of important changes across several lineages in terms of different responses to climatic

change that has been made in recent years. In many respects, it is extremely persuasive, and appears to be supported by a variety of evidence from East and South Africa. Conditions do appear to have become more arid in parts of East Africa after 2.5 million years ago (3). By the late Pliocene, semievergreen rain forest had been replaced by deciduous woodland, with some savannah grassland, although the latter did not become dominant until well into the Pleistocene. At Olduvai, there was a trend towards greater aridity that peaked at 1.77 million years ago.

Vrba's views have encountered a considerable degree of skepticism, although the criticism is usually less about the general soundness of the ideas than about whether the data - particularly those from East Africa - support her case. The main objections are that the main evidence for grasslands in East Africa is not until *ca.* 1.8 million years ago, rather than at 2.5 million years ago, and/or that the faunal record, if rigorously scrutinized, does not support clear correlations with a change in climate (3). Despite criticism of Vrba's argument, and counterproposals, there is a consensual view that the development of grasslands and the emergence of Homo *erectus* are closely linked, so to that extent, climatic change resulting in greater aridity and more open landscapes remains as a driving force behind an important phase in human evolution. Yet, the increased climatic variability at this time may also have been an important influence on faunal evolution (including that of hominins). We shall later consider these climatic and environmental changes from an Asian perspective and suggest how they might have affected early Asian hominins.

The First Evidence for Stone Tool-Making: Despite the possibility, in fact the likelihood, that hominins prior to the emergence of Homo *Habilis* made and used stone tools, Homo *habilis* is the first hominin solidly known to have fabricated stone tools, the technology referred to as the Oldovian industry after the Olduvai Gorge site in Tanzania in Africa, where these primitive tools have been discovered in association with Homo *Habilis* remains. Although they may look very simple or primitive, the Oldowan tools were quite a significant development in our human evolution For one thing, they greatly enhanced hominin’s access to meat: though not yet hunters of large game, these tools users could now better extract meat from scavenged animals. Second, there is no question that tool use is related to increased brain size and changes in brain structure in hominins. We do not know exactly how this worked but it is clear that a connection between brain development and tool technology is one of the earliest gene-culture interactions in our evolutionary history.

Stone tools become somewhat more sophisticated and somewhat more ubiquitous with the arrival of Homo *erectus*. The archaeological evidence is not particularly helpful in establishing whether Homo *erectus* was technologically superior to its contemporaries but what is clear is that stone toolmaking preceded the first appearance of not only Homo *erectus* but also the genus *Homo*, and was probably a skill practiced by several types of hominins after 2.6 million years ago.

The earliest stone tool assemblages from Africa are described in detail by Schick (14) and Toth (15,16). The oldest stine tools so far reported in Africa are from Kadar Gona, Ethiopia, where large numbers of unstandardized flakes and cores were found in secure geological contexts dated to *ca.* 2.5-2.6 million years ago. Similar artifacts have also been found at Bouri on erosional surfaces from *ca.* 2.5 million years ago. Slightly later assemblages, from *ca.* 2.3-2.4 million years ago, are known from the Omo Valley in Ethiopia and at Lokalalei (*ca.* 2.34 million years ago), on the west side of Lake Turkana, Kenya. A small in situ assemblage was also recovered from the 2.33 million years ago locality in Hadar, which contained a maxilla of *Homo*. In situ assemblages of stone artifacts, associated with animal remains, have recently been reported from several excavations of deposits

from 2.2 million years ago at Kanjera South, Kenya. The stone tool assemblages from Olduvai, and various localities at East Turkana (Koobi Fora) are from ca. 1.9-I.3 Million years ago, and should be familiar to most readers.





With edges both sharp and durable, a heavy, well-used flint tool (left) probably served its Neanderthal; owner as both hide scraper and the point of a thrusting spear. Neanderthals advanced the art of toolmaking with their method of preparing carefully shaped stone cores, from which they flaked of pieces of size and weight suitable to diverse tools. Modern humans brought lighter, more specialized tools to Europe - including narrow flint blades (right) that could

have been hafted to a throwing spear, making hunting more efficient and less dangerous (*National Geographic*)

These artifacts have usually been assigned to the Oldowan Industrial Complex, named for the definitive occurrences excavated and described by Mary Leakey at Olduvai Gorge, northern Tanzania. Oldowan artifacts tend to be remarkably crude and informal (Figure below), and they are notoriously difficult to separate among different types, probably because final tool form was determined primarily by the quality or shape of the initial blank, and not by a template in the maker's head. Partly in conjunction with this, Oldowan assemblages remained essentially unchanged for 800,000 years. Still, despite their crudeness and typological poverty, they reveal a mastery of stone flaking that even a tutored chimpanzee cannot readily match.

The Oldowan was initially regarded as a core tradition in which the production of "chopping tools" was seen as the most important output. Cores were thus classified as tools, and most of the flakes as waste items. These chopping tools were thought to have been necessary for dismembering the animals hunted or scavenged by Homo *habilis*, as well as providing the template of the later Acheulian handaxe (albeit after thousands of generations of practice). Subsequent assessments emphasized the importance of flake tools, and many "core-tools" are now regarded as the waste material left after several flakes had been obtained. Whether the



In some areas of the Old World, the only evidence for the presence of 'modern man' is the stone tools that he left behind.

Oldowan is seen as a core or flake tradition (or as a mixture of both), it is clear that the flaking output was primarily simple conchoidal flakes that had only a minimal amount of retouch.

The type and availability of raw material were also important influences on the outcomes of flaking. As an example, initial assessments at Olduvai indicated a stone technology that was generally big and chunky, of the type that might be expected from a horninin that was clumsy, and from a period when stone flaking was very much in its infancy. It was thus somewhat surprising when small and often precisely struck pieces of the same age were found at Koobi Fora. Specialists are now inclined to attribute the "chunkiness" of the Olduvai assemblages to the ready availability of quartzite, lava, and basalt and the small size of the Koobi Fora assemblages to the comparative scarcity of large rocks (in this case, rhyolite and fine-grained volcanics). Similarly, large amounts of stone (mainly fine-grained volcanic rocks and chert) were flaked at Kadar Gona,

w h e r e s t o n e w a s freely available, but in the Omo Valley, where s t o n e w a s v e r y scarce, hominins were forced to rely on small pebbles of coarse quartz that were difficult to flake predictably. Likewise, the hominins that foraged

on the flood-plains of Bouri (Ethiopia) 2.2 million years ago did so in a landscape largely free of stone, and relied on small nodules that were flaked until exhausted.

The Oldowan may have been technologically simple, but it was quantitatively and qualitatively very different from the type of flakes and debris produced by other primates. Although chimpanzees can flake stone both in the wild, albeit unintentionally as a by-product of using stone hammers to crack nuts, and orangutans and capuchin monkeys *(Cebus)* in zoo situations can flake stone, the flaking by these primates is far less precise, regular, and common than that of the hominins at Kadar Gona *ca.* 2.6 million years ago (14,15,16) and other places a little later. Around 2.6 million years ago we see the abrupt appearance of thousands of pieces of flaked stones and the sustained and frequent

production of sharp conchoidal flakes. At Kadar Gona, hominins were leaving large amounts of lithic litter, resulting from the repetitive and precise flaking of large numbers of stones at one place. As importantly, the stone knappers at Kada Gona were also skilful (in ways that non-hominin primates are not) at locating, selecting, testing, and procuring sources of high-quality, fine-grained stone for flaking.

Homo *habilis* is initially described as the first maker of chipped stone tools but later research showed that Homo was not the only genus who made and used tools. There is evidence that other primates, especially Australopithecus, also made and used tools. Distinctive types of stone tools are associated with various populations. More recent species with larger brains generally used more sophisticated tools than more ancient species. As it is not yet possible unequivocally to attribute stone tool making to any hominin taxon to the exclusion of others, the alleged ability to make stone tools should not be regarded as a reason for identifying a hominin specimen as *Homo.* Equally, the presence of simple types of stone tools around 2 million years ago,or even as late as 1.4 million years ago should not be automatically taken as evidence that *Homo* was the hominin that made them.

Around 1.4 million years ago, well after the initial dispersal of hominins, the Lower Paleolithic stone tool industry called *Acheulean* developed across parts of Africa, western Asia, up to the eastern edge of India, and eventually Europe. Technologically more advanced than Oldowan, the Acheulean tool kit provides us with convincing evidence of increasing tool dependence by hominins, who by this time inhabited several tropical and temperate regions of the Old World. Throughout this time, whether viewed in Africa or beyond, the archaeological record shows that hominins were slowly constructing the base elements of human culture.

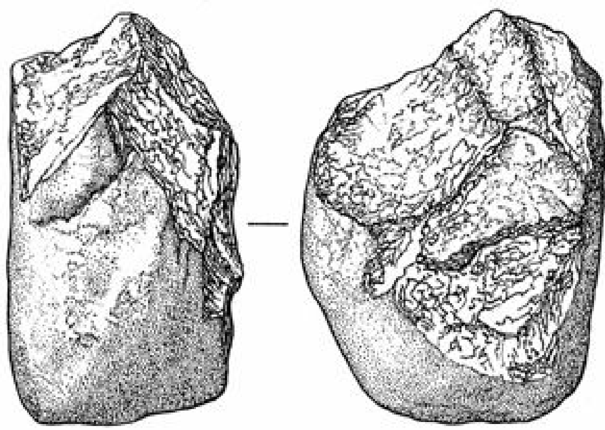
These tools are attributable to Homo *erectus* from Africa and their cousins in Eurasia. The Acheulean tool kit was both more diverse and more complex than the Oldowan, described above. It represented several new concepts about making stone tools. First, Acheulean tool makers invented the idea of a bifacial stone tool - one that has been worked to create two opposing faces (see figure below). A notable example of an Acheulean bifocal tool is the handaxe, thousands of which have been found at sites from Africa to Europe and eastward to Pakistan and India. Second, Acheulian toolmakers developed a new way to knock flakes from stone cores, which gave more predictable results than the methods previously used by their Oldowan predecessors. Finally, some kinds of Acheulean tools tend to reflect shared notions of form, or what they should look like. In other words, not only did Achaeulean toolmakers create new stone tools and ways to make them, they were also capable of developing and communicating to each other ideas of form and design. The degree of symmetry and standardization in form vary from site to site, but this may be due mainly to variability in the quality of raw material

The cleavers are much like handaxes except that they end in a broad straight edge rather than a point. While we still do not have a clear idea what

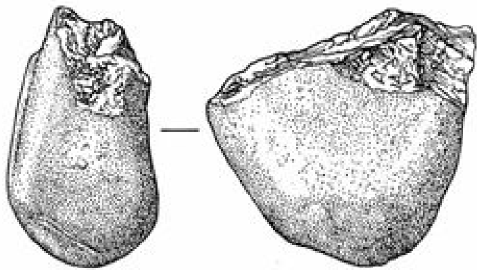
assigned to the Acheulean Industrial Complex, named for St. Acheul in northern France where an important handaxe occurrence was unearthed in

the first half of the 19th century. The

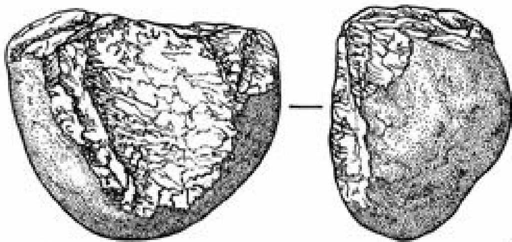
term “handaxe” is potentially misleading, since we know little about how skilled. They often produced bifaces



a



b



c



A few examples of Oldovai stone tools

cleavers were used for, handaxes show wear patterns and other evidence of having been used for many different kinds of tasks, especially cutting and chopping. Acheulean tool kit was not just handaxes and cleavers. It also included many kinds of flake tools, which were used for cutting, abrading, scraping, piercing, and other tasks, as well as hammerstones, cones, and other artifacts, many of which would also have been familiar to an Oldowan toolmaker.

Acheulean industry is of extraordinary duration, from 1.6 million years ago until perhaps 250,000 years ago. By 600,000 to 500,000 years ago, the Acheulean occupied a vast area, from the southern tip of Africa to England and from Spain to

India. Bifaces did not appear in South Asia until 500,000-700,000 years ago and in Europe until about 600,000–500,000 years ago, possibly as a result of cultural diffusion but more likely as a result of population movement from Africa. The bifaces found near St. Acheul, after which these types of artifacts were named, are probably 400,000–300,000 years old.

Bifaces failed to penetrate eastern Asia. (east of India), and the reason is obscure. One possibility is that the first east

Asians were Oldowan people, who expanded from Africa prior to 1.8 to 2 million years ago, before the Acheulean emerged (17). A better-substantiated possibility is that the first east Asians arrived much later, near 1 million years ago, but abandoned classic handaxe manufacture early on and subsequently developed their own distinctive artifact tradition, perhaps supplemented by novel tools in bamboo (18). In keeping with archeological separation from the West by 1 million years ago, eastern Asia also seems to have nurtured its own distinctive human lineage or lineages.

Asia *versus* Africa: The story of human evolution, as routinely told in the classroom and as summarized in the above, is exceedingly streamlined and rather simplistic: *Australopithecus* evolving into Homo *habilis,* Homo *habilis,* in turn, giving birth to various forms of Homo *erectus,* these eventually evolving into *archaic* Homo *sapiens*, which later being replaced by a more 'sapient' Homo (Homo *sapiens sapiens*). The schematics such as the figure below abound - all action being taken place in Africa. This tale is, of course, based on

The Acheulean
undoubtedly had its roots in the Oldowan,

standardization in form vary from site to site, but this may be due mainly to variability in the quality of raw material or in the distance to raw material sources.52 Conceivably, aesthetic considerations underlie the most attractive pieces, but strictly utilitarian con

handaxes were used, and they vary straints cannot be ruled out, since
some credible fossil evidence but laced with a hefty biface functions are so poorly under
doze of conjecture and a handful of speculation.knappers werestood. There is no other compelling
of flaking on two opposed surfaces evidence for art or aesthetics duringThis scenario is well accepted by most of archaethe long Acheulean time span.
the periphery (Fig. 3). In keeping with Bifaces did not appear in Europe
ologists, anthropologists and prehistorians. Whenuntil about 600 –500 ky ago, possibly
viewed close up, however, the actual process ofas a result of cultural diffusion but
pointed pieces that are handaxes in on large flakes that were difficult to more likely as a result of population
human evolution and expansion is probably a greatmovement from Africa. Europe apdeal more complicated than this simple scenario,pears to have been only sporadically
A few examples of bifaces
and alternative scenarios can be suggested (3).Figure 3. Bifaces from Torralba, Spain (reMost of these scenarios assign a prominent role to
drawn from originals provided by F.C. Howell and L.G. Freeman). The artifacts proba
Asia in the evolution of man. Most of the popular
bly date from between 600 and 400 ky ago, but they differ little from African bifaces

debate revolves around the emergence and disperthat are at least twice as old. sal of 'modern human' while the world of "pre
modern" or "archaics" humans and their ancestors
is relegated to a background noise. The dissenting
voices attempt to correct this imbalance.

The crux of the matter is: do the early
hominins and the 'archaics' have anything to do
with the evolution of modern humans? and does
Asia has anything to do with human evolution?

While there are scholars who believe that ‘modern man’ recently evolved in Africa (some 150,000 years ago) from where it spread all over the globe (starting some 70,000 years ago), there are some who view the evolution of modern man as a contin uum, the evolution of a single species right from the beginning (some 2.5 million years ago), a process in which Asia probably played as important a role as Africa. For these scholars, there is reason to sus pect that Africa may be only part of the cradle of humankind, and that the "cradle" extends over into Asia (19).

To begin with, the number of new taxa dis covered since I994 implies that we do not yet know how many hominin taxa there were in Pliocene Af rica, or their full range of habitats. More importantly, it is not yet certain that australopiths were exclu sively African. The climatic and vegetational boundaries between Northeast Africa and South west Asia are likely to have fluctuated considerably during the Pliocene, and it would appear premature to assume that australopiths never "spilled over" into the Arabian Peninsula or even further inland when conditions were favorable. Although most of the new information on Pliocene hominins comes from East Africa, we need to remember that this is the best-researched area of Africa, and large parts of central, western, and southern Africa remain unexplored.

The more important set of uncertainties concern the origins of *Homo erectus* in Africa. The fundamental assumption in this “big picture” is that *Homo erectus* emerged in East Africa *ca.* 1.9 million years ago, and then shortly afterwards expanded its distribution into Southwest Asia *ca.* 1.8 million years ago and reached Java and North China by *ca.* I.6 million years ago. Also, it was the progenies of Homo *erectus,* again in Africa, that gave birth to modern humans, namely, to Homo *sapiens*. However, there is no clear evidence of the ancestor of Homo *erectus* and thus there is no clear evidence that its ancestors were necessarily East African; it remained a highly variable species during the Early Pleistocene; its brain size, body proportions, degree of sexual dimorphism and rate of development do not seem to have been particularly "modern"; and there is no clear evidence that it was technologically more proficient than its contemporaries *ca.*1.9 million years ago.

Indeed, in some evolutionary circles, the morphological distinctions between all human-type forms are insufficient to justify a separate species classification for *erectus* - that is, that all posthabiline forms (*erectus*, archaic and modern *sapiens* plus the Neanderthals), could be subsumed into a single species *Homo sapiens*, with a subspecific distinction at most. They point out that genus Homo generally displayed a remarkable degree of structural stasis over the whole period from *ca.* 1.9 million years ago to about 350,000 years ago. The morphology of the earliest specimens such as the Turkana Boy differs insignificantly from the much later specimens such as the Peking and Javan examples, the only significant difference being restricted to the endocranial volume. At full

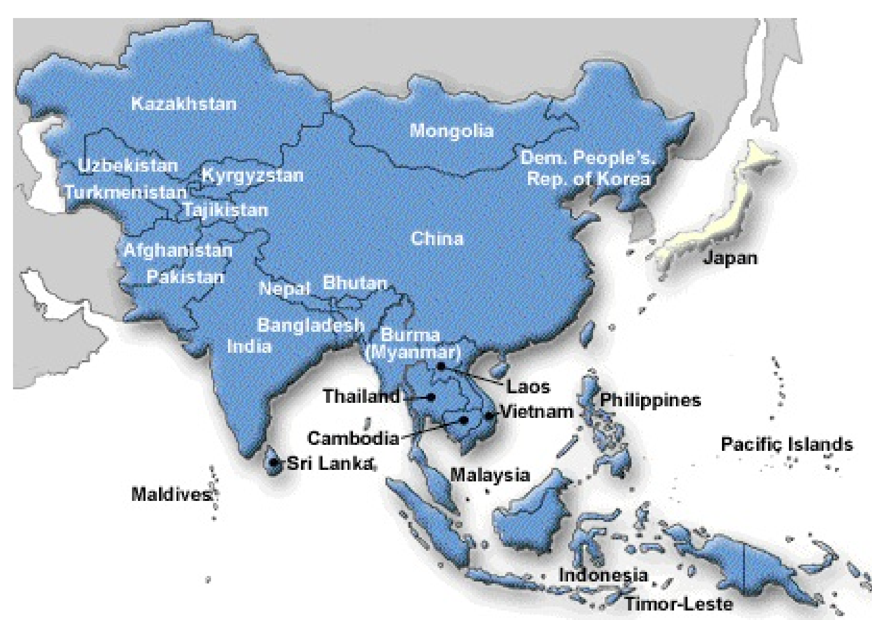
adulthood, the Turkana Boy would have possessed a capacity of about 1000-1050 cc, compared to later Chinese examples which were as high as 1200 cc. The modern human range runs from about 700 cc to 2200 cc, and this puts every adult Homo *erectus* specimen comfortably into the range of modern humans, and this range also covers every adult example of archaic, *sapiens*, Neanderthal, and CroMagnon Man.

Now, if the distinctions between *erectus* and modern humans are merely superficial, then the differences between the earliest and the latest *erectus* specimens, and between *erectus* and archaic sapiens and the Neanderthals are even more superficial; that is, there is a great probability that all *erectus*, Neanderthal and Homo *sapiens* are closely related, with genetic, dietary, climatic, and other environmental diversity in evidence, so the argument goes. They also point out the presence in Australia of both modern sapiens types and *erectus* types all within the last 35,000 years. One explanation given by the mainstream scholars is that the *erectus* fossils are only late-surviving relics of Homo *erectus*, but this seems very doubtful seeing that *erectus* elsewhere in the world is supposed to have died out around 300,000 years ago.

Recent artifact discoveries in Asia, such as those discovered in Pakistan, and discoveries of human fossils in the Caucasus are greatly expanding our understanding of the earliest hominin inhabitants in Asia and questioning conventional thinking that Asia was a ‘passive recipient‘ rather than an active donor in the earliest transcontinental hominid dispersal (3,20).

Such divergent views are, however, discounted or simply dismissed by mainstream scientific community because these scenarios leads us to a ‘creation theory’ in the garb of science. This may as well be true but we still have to contend with the ‘multi-regional’ hypothesis for the evolution of moderrn man, discussed in the next chapter. As will be seen, it is a well-accepted theory by a substantial part of the scientific community for explaining the evolution of man. To round off the discussion, in due course we shall specifically comment on two dissenting voices, one relating to the evolution of human species in Asia and the other speculating on the dispersal of ‘modern’ humans throughout Eurasia through a combination of demic diffusion coupled with genetic admixture and replacement.

II.3. The Earliest Inhabitants of Asia



In recent years, much interest has been aroused, both publicly and academically, by the possibility that hominins may have occupied large parts of Asia by a little under two million years ago, rather than the substantially later date of around one million years ago, as was previously and commonly believed. The doubling of the antiquity of hominins in Asia has been brought about by a handful of new discoveries and the re-dating of older ones. New discoveries include the superb hominin remains and stone artifacts from Dmanisi, Georgia, dated to a little under 1.8 million years ago (10,21,22,23); claimed hominin remains and alleged stone artifacts from the fissure at Longgupo, China, which may be as old as 1.8 million years ago (24); convincing examples from Riwat, Pakistan of intentionally flaked stone in a horizon dated by both the discoverers (25) and previous, independent geological teams (26) to the late Pliocene, *ca.* 1.9 million years ago; and most importantly, the re-dating of the hominin remains from Sangiran and Mojokerto, Java, to *ca.* 1.81 and 1.66 million years ago (17), respectively. The Javan dates are critically important here, for not only were these hominins long regarded as being less than one million years old but until the discoveries at Dmanisi, they were also the only lower Pleistocene hominin remains between Southeast Asia and East Africa, some 8000 km to the west. Even though the dating, context, and/or identification of each of these finds has been criticized, as is also the case with other sites, the suggestion that hominins first occupied Asia around 2 million years ago has become an almost orthodox view within paleoanthropology (8).

Parallel to this interest in the occupation of Asia by early hominins, there has been similar interest in when and from where anatomically modern humans first appeared in Asia. We have touched upon this topic in the foregoing chapter tangentially and discussed in the next chapter in some details and need not be repeated here. This chapter exclusively relates to the early pre-modern hominins in Asia.

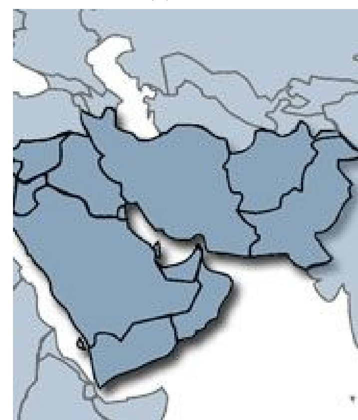
When we speak of the early inhabitants of Asia, we generally speak of Southeast Asia and China on one hand, and the West Asia and the Caucasus on the other hand. It is here that suitable human fossils have been found and analyzed. There are no fossil records of Homo *erectus* or any other early humans in Pakistan; nor there is any such evidence available from its immediate neighborhood, namely Arabia, Afghanistan, Iran, and central Asia. India presents a partial cranium but it is of comparatively of recent age, most probably around 300,000 years ago. There is, however, a good array of stone artifacts available, and this has been used to shed light on their makers.

Fossil evidence for hominins before one million years ago across the vast expanses of the Indian subcontinent, Southwest Asia, Central Asia, Southeast Asia, and China is at present very thin on the ground. The most important fossil hominin evidence comes from Java, Indonesia, and the main archaeological evidence from the Nihewan Basin, North China. There is also a small amount of artifactual evidence from Pakistan (the Pothwar Plateau, in the north of Punjab), Southwest Asia and South China. This evidence shows that Asia became populated by early humans quite early on in the Pleistocene epoch. The Asian archaeological record may not be extensive but is enough to enable us to paint a general picture of Pleistocene Asia with a fair degree of accuracy.

As observed elsewhere in this book, Asia is the largest continent and it is where a substantial part of early human history took place in the last two million years. Yet, it has been long neglected by researchers who concentrated more on Africa and Europe. As a result of this neglect, most accounts of early human prehistory are biased towards evidence from Europe and Africa, with often only brief mention of what is known from Asia. One unfortunate result of this bias is the prominence that it usually ascribed to European evidence. But, as Dennell observes (3): “Europe is little more than the western peninsula of Asia, and was often a very small tail wagged by a much larger dog”. Much of what happened to hominins in Europe in the Pleistocene was an extension of climatic and faunal developments further east, and better understanding of these would probably benefit perceptions of Europe’s own early prehistory (3).

Within Asia, there are several researchers who know an immense amount about their own regions, but far less about neighboring ones. This is entirely understandable given the size and diversity of the continent, but it has inhibited attempts to see Asia’s prehistory at a continental as well as on a regional level. Robin Dennel’s *The Paleolithic Settlement of Asia* is probably the only account of Pleistocene Asia, consolidating the details of local regional records with a continental perspective. The following summary takes advantage of this detailed account.

SOUTHWEST ASIA



Southwest Asia, at the crossroads of three continents, is critical for understanding the Early Paleolithic of the Old World. Any hominin population leaving Africa would have had to pass through Southwest Asia on its way to Europe, Central Asia, the Indian subcontinent, mainland Southeast Asia, China, Indonesia,

and ultimately, for modern humans, Alaska and Australia. Southwest Asia, however, is more than an incidental stepping stone on the way to other areas. Its location justifies treating it in some detail along with the Caucasus, the Far East and South Asia.

Climate and Relief: Southwest Asia varies enormously in its climate and relief. Climatically, it lies west of the Indian summer monsoon (apart from the Yemeni Mountains), and is thus an area of winter/spring rainfall, most of which is delivered by westerly winds from the Mediterranean. Outside the Levantine coast (Israel and Lebanon), Turkey, and the Zagros Mountains of Iran, most of Southwest Asia is now desert, and aridity is the key climatic variable. Rainfall varies from *ca.* 600 mm along parts of the Levantine coast to annual averages of less than 100 mm in the deserts of the Negev, southern Israel, much of Arabia, and the Iranian Plateau. Consequently, it is likely that the core areas of hominin residence would have been in those area such as the Levant and western Turkey, where rainfall was highest.

Rainfall can vary enormously from year to year, so that annual averages are not particularly useful climatic indicators, especially in desert regions, even when evaporation rates are also taken into account. Annual temperatures vary enormously, with some areas such as Arabia and Iran routinely experiencing daytime summer temperatures of more than 40°C but cool (and generally frost-free) winters. Other areas, notably Eastern Turkey and parts of the Zagros Mountains, have slightly cooler (but nevertheless still hot) summers but very cold winters, with temperatures sometimes below -20°C and deep snow.

In terms of relief, Southwest Asia contains the Dead Sea Valley (400 m below sea level) and mountains (mainly extinct volcanoes) over 5,000 m high in eastern Turkey and northern Iran. The Zagros Mountains are a major mountain chain over 1,500 km long along western Iran, with peaks over 4,000 m and dividing the lowlands of Mesopotamia from the Iranian Plateau, which has an average altitude of 1,000 m. Apart from the Tigris-Euphrates river system of Iraq, Syria, and Turkey. Southwest Asia as a whole is not well endowed with large perennial rivers. This is especially true of Arabia, which now has none, and Iran, which has only one, the Qara Su, which flows through the Zagros Mountains into the Euphrates. Availability of perennial water would thus have been a major constraint on early hominins throughout Southwest Asia. In areas away from major rivers, the main water supplies would have been lakes and springs, especially along some mountain ranges. As seen below, most of the evidence for Early Pleistocene hominins in Southwest Asia comes from the edges of extinct lakes and streams.

The Main Sources of Archaeological and Fossil Hominin Evidence: It has been shown that many areas that are now desert were probably semidesert or grassland in the Late Pliocene and Early Pleistocene. Lakes were also more numerous than now. As these would have been attractive to both hominins and their prey, and are also good low-energy environments for preserving animal bones and stone tools, they offer the best prospects for learning about hominins in Southwest Asia. It is thus not surprising that most of the evidence for hominins in this region comes from former lake systems. These include the most famous Early Pleistocene sites in Southwest Asia, such as Ubeidiya in Israel (*ca.* 1.4 million years old).

Ubeidiya: The site at Ubeidiya contains some of the best artifactual, faunal, and taphonomic evidence for a site of this age in the Old World, as well as the earliest evidence for Acheulian bifacial technology in Asia. Its location is shown in the map below.

The Artifact Assemblages: The Ubeidiya artifact assemblages are important in two ways. The first is their similarity to roughly contemporaneous assemblages from Olduvai Gorge, that are classified as "Developed Oldowan" because of similar tool-types (notably core-choppers, polyhedra, spheroids,

and heavy-duty scrapers), and the low frequencies of bifaces. Some examples of these Oldowan type tools from Ubeidiya are shown in the figure below. These similarities are considered so great that parallel cultural evolution is thought extremely unlikely, and are instead attributed to hominin dispersals from Africa into the "Levantine corridor" (28). This appears additionally reasonable as the earliest bifaces are clearly African, such as those from *ca.* 1.6 million years ago at KonsoGardula, Ethiopia. Two reservations may be offered, however. The first is that we do not know when bifaces were first used at Ubeidiya (or elsewhere in Southwest Asia) because the lowest deposits have few artifacts. All we know is that bifaces were not used at Dmanisi, *ca.* 1.7 million years ago, but were used by 1.4 million years ago at Ubeidiya: there may be earlier examples of bifaces in southwest Asia between I.4 and 1·7 million years ago. Second, the similarities in age and type of the bifaces at Ubeidiya and at Olduvai Gorge could have resulted from the transmission of flaking techniques between contiguous groups, rather than the migration of hominins.

Ubeidiya has produced one of the largest sets of Early Acheulian assemblages and these are especially valuable in illuminating the behavioral capabilities of their makers.The Ubeidiya evidence does not support the idea that hominins at this time used specific tool-kits in particular environments or for particular sets of activities.On the other hand, hominins did appear to express clear preferences over the types of stone that should be used for making specific artifact types. The main types of stone available at Ubeidiya were basalt, flint, and limestone. Basalt occurs as pebbles and cobbles (i.e., in different sizes of water-worn material), but basalt flows and dykes occur nearby. The source of limestone is unknown but it could have come from nearby outcrops. Flint is found as pebbles and cobbles in beach and wadi deposits, and could have been transported in nearby alluvial fans. Each material was consistently used for making different kinds of tools: chopping tools and polyhedra were consistently made from flint, bifaces mainly from basalt, and spheroids almost always from limestone. An additional interesting detail is that the absence of small basalt flakes but the presence of small flint ones may indicate that bifaces were made elsewhere and brought ready-made to where they were used and discarded (3)·

"Living Floors": One of the most distinctive features of the Ubeidiya sediments was "thin 'pavements', often only one or two cobbles and pebbles thick - composed of basalt, limestone, oolitic limestone and flint cobbles and pebbles" (29). Because artifacts and animal bones were found embedded in and on these pavements and in the overlying clay layers, they were termed "living floors". In most cases, the artifacts were found in and on the pavements, and animal bones were usually in clay deposits away from the stone "pavements". Additionally, there was a clear correlation between the state of preservation, state of patination, and type of environment: lithic artifacts in conglomerates or beach deposits were more abraded and patinated than those in low-energy clays, silts. and fine sands; that is, they had been subjected to the same agencies as their depositional environment (3). As pointed out above, the frequencies of tool-types in the Ubeidiya assemblages varied independent of their sedimentary context, so assemblages from "living floors" were not different from those in other contexts. The interpretation of these "living floors" has proved problematic, as with similar exposures of artifacts and bones at sites in East Africa and Europe. The three main options are that these were entirely natural, entirely artificial, or natural surfaces modified by hominins. Israeli archaeologists have been reticent to argue that Ubeidiya contains "living floors" as originally envisaged for some sites in Olduvai Gorge (3).

Many years ago, Tchernov (30) argued at length that there were no "living floors" at Ubeidiya. This study effectively kills the notion that there were "living floors" at Ubeidiya, in the sense that the

artifacts and faunal remains represent the remains of distinct, short-term camps. In his view, artifacts were not discarded onto a clay substrate that would often have been muddy. Lake shores were also dangerous environments in which to camp because of predators such as crocodiles. Instead, he suggests that hominins would have "raided" the foreshore for food (such as various plants, small mammals, reptiles, amphibians, migratory birds, fish trapped by receding lake levels, or carcasses of larger mammals killed by carnivores) and then discarded any artifacts when carrying food back for consumption at a safer locale. Over millennia, this type of small-scale discard would result in the type of artifact distribution initially interpreted as a "living floor".

Dating: The dating of Ubeidiya proved difficult, as there are no volcanic ashes within the exposed units, and its age is very loosely constrained by the ages of older and younger deposits nearby. Initial age estimates varied from 0.8 to 2.6 million years ago, and it was not until Tchernov (30) compared the faunal remains to those well dated in other sequences in Africa and Europe that a clearer indication emerged of its probable age. He showed that, allowing for sampling and dating errors, the animals represented at Ubeidiya would have been found together between I.4 and 1.0 million years ago, with a higher probability of an age around I.4 million years. Given the geographical position of Ubeidiya, it is not surprising that the fauna includes animals from sub-Saharan and North Africa, Europe, and Asia, as well as those endemic to the Jordan Valley.

The Arabian Peninsula: The Arabian Peninsula, covering over a million square miles, is often mentioned as the most obvious route by which hominins would have migrated out of Africa into Asia, either across the Bab al Mandab Strait, or at the north-end of the Red Sea and across the Sinai Peninsula. Although the southern and western side of the Arabian Peninsula are mountainous, the northern part unfolds gently westwards to the Mediterranean, north to southern Turkey, and east to the Zagros Mountains. It should thus be an area where hominin populations could easily have moved over large distances.

Despite its size and geographical importance as a potential bridge between two continents, the early hominin record of the Arabian Peninsula is almost unknown. The Arabian peninsula is indeed the Rub-al-Khali, or the Empty Quarter of paleoanthropology in the Old World (3). Although this ignorance can partly be attributed to lack of fieldwork, there are genuine taphonomic reasons that it figures so little in discussions of the early inhabitants of Asia. Granted that a few sites have recently been discovered the artifact of which can be attributed to Oldowan and Acheulian typology but these divisions are rather arbitrary (31). Investigators have understandably borrowed the terms used in the neighboring and better documented territories of East Africa and the Levant. "Oldowan" assemblages comprise

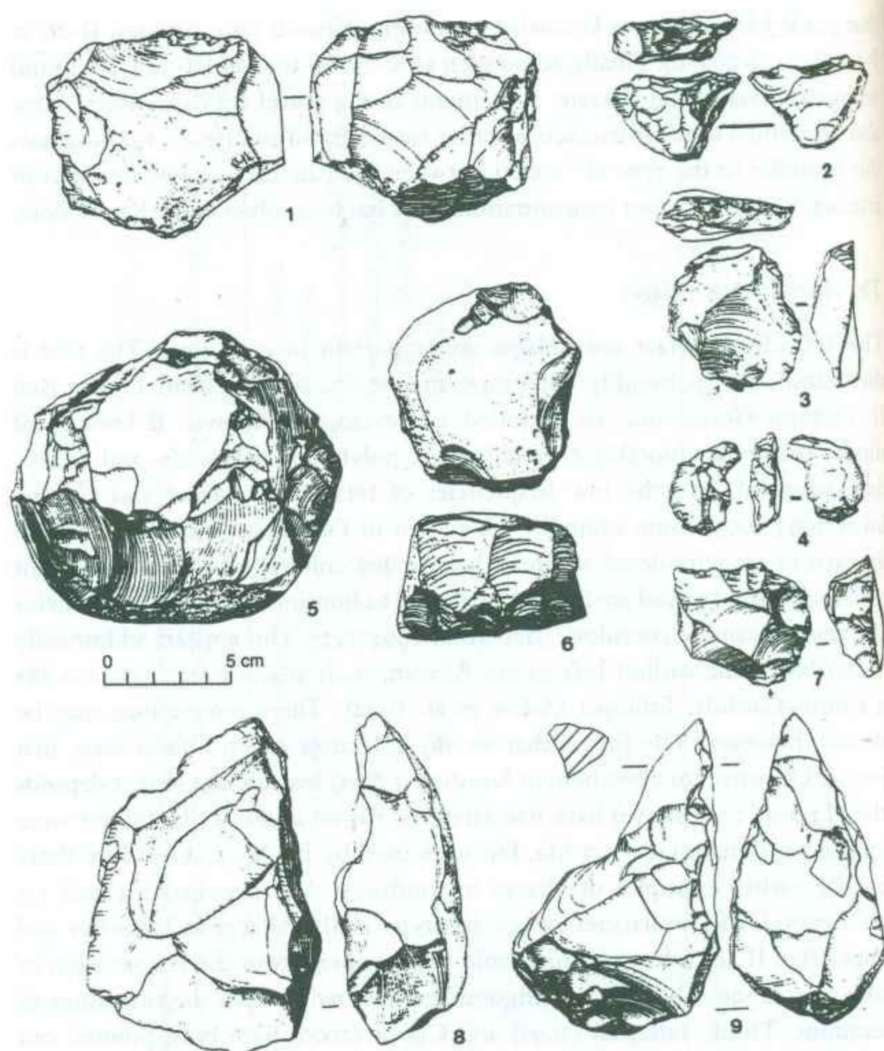


Figure 4.10. Oldowan-type artefacts from 'Ubeidiya. (1) Polyhedron; (2, 4, 7) retouched flakes; (5) spheroid; (6) heavy duty scraper; (8) core; (9) trihedral pick. *Source:* Bar-Yosef 1994, Figure 8.

is taken to represent different groups of people". This inference is at odds with the original analysis, which emphatically rejected that suggestion: "The typological variability at 'Ubeidiya was previously interpreted, following the example of Olduvai, as the coexistence of two distinct cultural traditions . . . but is currently viewed as belonging to the Early Acheulean tradition" (Bar-Yosef and Goren-Inbar 1993:196). This assessment seems entirely reasonable.

As 'Ubeidiya has produced one of the largest sets of Early Acheulean assemblages, it is especially valuable in illuminating the behavioural capabilities of their makers. Two patterns have emerged. The first is the underlying

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Figure 4.10. Oldowan-type artefacts from 'Ubeidiya. (I) Polyhedron; (2, 4, 7)
retouch **Some examples of Oldowan type tools from Ubeidiya** pick.
Source: Bar-Yosef 1994, Figure 8.
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Yosef and Goren-Inbar 1993:196). This assessment seems entirely reasonable. polyhedra, and some ovate and cordiform
han As 'Ubeidiya has produced one of the largest sets of Early Acheulean assem

daxes. "Middle Acheulean" denotes assemblages with their lanceolate Two
and patterns trihedral ed. bifaces, is polyhedra, spheroids, trihe- dral picks, choppers and bifacial knives, and hard hammer flaking; and the "Upper Acheulean" refers to assemblages with smaller handaxes with ovate or cordiform shapes, the use of soft hammer percussion, and the presence of some Levallois technique. Nevertheless, detailed similarities between known Oldowan and early Acheulian assemblages in, for example, Israel or East Africa and ones from Arabia should not be dismissed out of hand, even if such similarities remain unsubstantiated without secure dating. As Dennell declares (3), until there are secure dates for the Early Paleolithic of Arabia, this region will neither challenge nor confirm existing views about the early history of our own genus outside Africa.

To elaborate the last point further, it is implicitly assumed that the earliest artifacts in the Arabian Peninsula were made by groups of *Homo erectus* that migrated from East Africa, and must therefore be more than1.8 million years old. It should, however, be kept in mind that *Australopithecus garhi* was making stone artifacts in nearby Northeast Ethiopia shortly after 2.6 million years ago (3), and the possibility cannot be excluded that the earliest artifacts in Arabia were made well before 1.8 million

The years ago, and/or by a hominin other than Homo *erectus*.

Petraglia (31,32) usefully summarized what is known of the Lower Paleolithic of the Arabian peninsula. Most Lower Paleolithic material has been found in extinct wadi systems and terrace deposits in the western part of Saudi Arabia and Yemen. Pliocenee and Pleistocene deposits are rare on the eastern side, there are no definite Paleolithic sites in Bahrein, the Gulf States, Kuwait, Qatar, or the United Arab Emirates. At least three main rivers flowed across Arabia in the Early Pleistocene, but without entering the sea. Most Early Paleolithic sites come from extinct wadi drainage systems that may have been related to these major channels. One of the best examples of an Oldowan site is in Northwest Saudi Arabia, and is known by its local name of Shuwayhittiyah. Here, sixteen concentrations of artifacts were found over a large area extending some 4 km along weathered wadi terraces, in a small narrow valley and flat plain. Sadly, test excavations showed that the deposits were very shallow. A total of 1 , 5 1 7 a r t i f a c t s were collected. The largest locality covered 78,324 sq.m and the smallest, 2,I 80 sq.m. The tool industry is thought to be like the developed Oldowan A of Olduvai. Of the artifacts, 39.58% were choppers, 5.2% polyhedra, 5.8% spheroids and sub- spheroids, 7-4% bifaces, and 9.8% were classed as small tools. A few are shown in the figure above.

Besides lower paleolithic artifacts, archaeologists found three different paleolithic settlements which date from 125,000 years ago to 25,000 years ago (142). These indicate that early human groups


One of the hand axes from Jebel Faya, UAE

were living around the Persian Gulf basin throughout the Late Pleistocene. The stone tools found at the site of Jebel Faya, some up to 125,000 years

old, resemble those made by anatomically modern

humans in Africa around the same period. Their

makers crossed the Red Sea, trekked across Arabia
during favorable climate conditions, and perhaps
went on to settle in Asia.

Persian Gulf, equal at times to the size of Great Britain. Therefore, when the hinterlands were desiccated, populations could have contracted into the Gulf Oasis to exploit its freshwater springs and rivers.
subterranean aquifers flowing beneath the Arabian subcontinent. Inverse to the amount of annual precipitation falling across the interior, reduced sea levels periodically exposed large portions of the

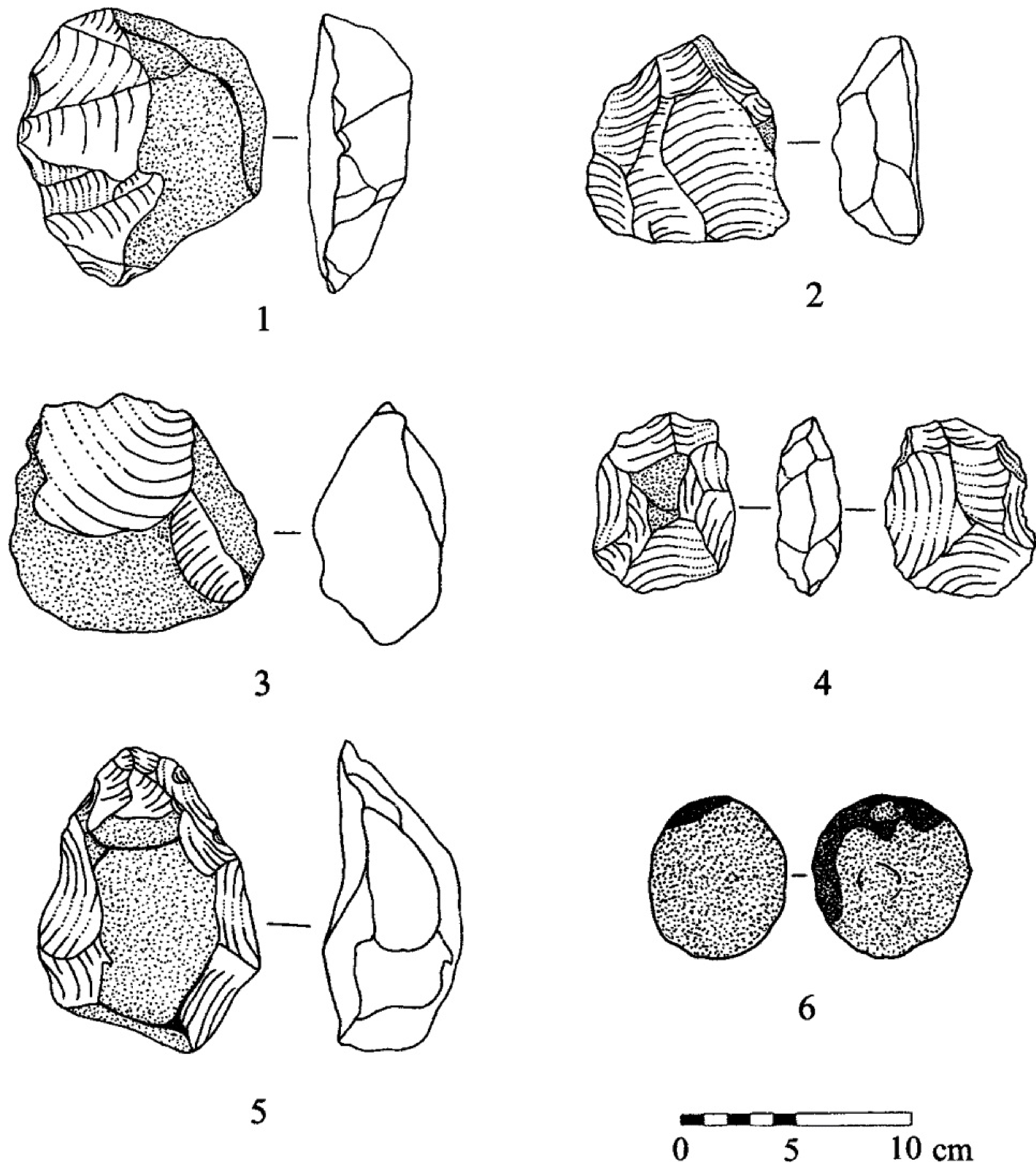


Fig. 6. “Oldowan” artifacts recovered from Shuwayhitiyah, (1–3) choppers, (4) discoid, (5)

Oldowan type artifacts from Arabian peninsula (31)

tools) was noted to be similar to Developed Oldowan B industries. The assemblages differed from the Olduvai assemblages in overall size, as tools and debitage from Saudi Arabia were larger in one or more directions. In an overall appraisal, the investigators conclude that, “the first inhabitants atThe data showed that 130,000 years ago, the

Shuwayhitiyah belonged to a culture described as Oldowan A, as both arte
Arabian Peninsula was relatively more warm which
fact forms and correlation coefficients suggest, to be replaced many thou
caused more rainfall, turning it into a series of lush
sands of years later by groups with an ensemble of tools defined as Developed

habitable land. During this period the southern Red Sea's levels dropped and was only 2.5 miles or 4 km wide. This offered a brief window of time for humans to easily cross the sea and cross the Peninsula to opposing sites like Jebel Faya. At the very minimum a find like this tells us humans left Africa a bit sooner than we thought.

The emerging picture of prehistoric Arabia suggests that early modern humans were able to survive periodic hyperarid oscillations by contracting into environmental refugia around the coastal margins of the peninsula. Jeffrey Rose (143) reviews new paleoenvironmental, archaeological, and genetic evidence from the Arabian Peninsula and southern Iran to explore the possibility of a demographic refugium dubbed the "Gulf Oasis," which is posited to have been a vitally significant zone for populations residing in southwest Asia during the Late Pleistocene and Early Holocene. These data are used to assess the role of this large oasis, which, before being submerged beneath the waters of the Indian Ocean, was well watered by the Tigris, Euphrates, Karun, and Wadi Batin rivers as well as This dynamic relationship between environmental amelioration/desiccation and marine transgression/regression is thought to have driven demographic exchange into and out of this zone over the course of the Late Pleistocene and Early Holocene, as well as having played an important role in shaping the cultural evolution of local human populations during that interval.

CAUCASUS



Caucasus is relatively a new frontier in the study of early inhabitants of Asia and the evolution of humans in general. The site of Dmanisi in Georgia is arguably the most exciting site of its age

in either Asia or Africa, and its fossil hominin evidence in particular has immense implications for the history of our own genus, and especially of Homo *erectus*. Dmanisi provides a stunning example of the unpredictable nature of paleoanthropology. Before its discovery, no one would have predicted that one of the most important discoveries for understanding both the early history of our own genus, and its early history outside Africa, would be made in the Caucasus Mountains of Georgia, and especially during restoration work inside a medieval castle. Ongoing research will doubtless generate further surprises, but enough is now known from Dmanisi for an interim summary of the main results and their wider implications. Numerous accounts are now available, such a Balter and Gibbons (33,34), and Gabunia et al. (66,67,68). An excellent summary is by Dennell (36). A most recent exposition is that of David Lordkipanidze (131).

TheHomininRemains: It is the hominin remains that have rightly attracted so much attention, and few discoveries of hominin remains have had the same seismic consequences for longestablished ideas. We can begin first with the main finds and their taxonomic assessment. The most important discoveries have been five largely intact crania, three mandibles, and a substantial amount of postcranial evidence. Many of these specimens were surprisingly complete and unweathered at the time of deposition. All were buried shortly after the end of the Olduvai Event, *ca.* 1.77 million years

ago.

The first hominin discovery was a mandible (D211), found in 1991, which was important at the time in being the oldest of its kind from western Asia, but not otherwise particularly controversial. After comparing it to other specimens, notably from East Africa, China, and Java, Gabunia and Vekua (144) concluded that it was probably best classified as belonging to an early population of Homo *erectus sensu lato*, that is, including specimens from both Africa and Asia. As such, it was entirely compatible with the view that Homo *erectus* originated in Africa and migrated across Asia *ca.* 1.7 million years ago.



The Earliest Inhabitants if *Southwest Asia*

with the African early Homo *ergaster*, rather than the East Asian Homo *erectus* s.s.. As such, these new finds appeared to extend the geographic range of Homo *ergaster* outside Africa and into Southwest Asia, as well as its morphological variability. According to Gabunia et al. (10), the new evidence indicated that "these hominids may represent the species that initially dispersed from Africa and from which the Asian branch of Homo *erectus* was derived". It was, in other words, a very early version of Homo *ergaster*, as well as a putative ancestor of the East Asian Homo *erectus*.

Matters became even less clear following the discovery of the third cranium (D2700) which was associated with a second mandible (D2735) and ten isolated teeth in layer BI. Cranium D2700 was even smaller-brained than the other two, with a cranial capacity estimated as only 600 cc, which is close to the average for Homo *habilis*. Vekua et al (35) suggested that if the new finds are added to the previous ones, "The Dmanisi specimens are the most primitive and smallbrained fossils to be grouped with this species or any taxon linked unequivocally with genus *Homo* and also the ones most similar to the presumed

Figure 4.4. Cranial specimens KNM-ER 1813 (left) and D2700 (right) from Dmanisi.
Source: Rightmire et al. 2006, Figure 5·

1. CRANIAL AND DENTAL EVIDENCE

The first hominin discovery was a mandible (D21 I), found in 1991, which was important at the time in being the oldest of its kind from western Asia, but not

otherwise particularly controversial. After comparing it to other specimens, notably from East Africa, China, and Java, Gabunia and Vekua (1995) concluded that it was probably best classified as belonging to an early population of H. *erectus* sensu lato, including specimens from both Africa and Asia. As such, it was entirely compatible with the view that H. *erectus* originated in Africa and migrated across Asia ca. 1.7 Ma.

Figure 4.3 Cranial specimens from Dmanisi (Rightmire, 2006**)**. *Source:* Rightmire et al. 2006, Figure 1.

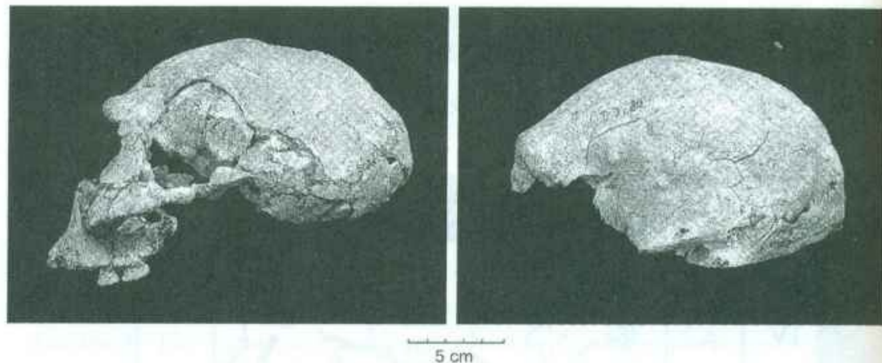


Figure 4.3. Cranial specimens D2282 (left) and D2280 (right) from Dmanisi. *Source:* Rightmire et al. 2006, Figure 1.

attached. The faunal remains are also remarkably complete. Of 3,000 vertebrate remains, 30% are unbroken, and 90% are identifiable to genus. In addition to four hominin crania and three mandibles, there are a complete skull of *Stephanorhinus etruscus*, a skull of *Cervus perrieri*, with a full rack of antlers, a *Dama nesti* antler, two crania of *Canis etruscus*, a complete mandible of *Equus stenonis*, and the anterior portion of a *Megantereon* cranium. Details are currently lacking on how much of the postcranial skeletons of these animals are preserved.

There are few obvious taphonomic parallels for Dmanisi, and the only analogy offered by Gabunia et al. (2000a) is a Siwalik Miocene fossil locality where fossils were also found in cavities hollowed out by groundwater. The abundance of carnivore remains at Dmanisi (including those of juveniles), carnivore coprolites, and bones with carnivore tooth marks (ca. 7% of the total) suggests that carnivores played a large part in accumulating the fossil assemblage. However, bones with tool marks and numerous artefacts imply that hominins played some role in modifying, and possibly accumulating, the fossil remains (Lordkipanidze et al. 2006: 1148).

The Hominin Remains

It is the hominin remains that have rightly attracted so much attention, and few discoveries of hominin remains have had the same seismic consequences for long-established ideas. We can begin first with the main finds and their taxonomic assessment. The most important discoveries (some of which are shown in Figures 4.3 and 4.4) have been four largely intact crania, three mandibles, and a substantial amount of postcranial evidence. Many of these specimens were surprisingly complete and unweathered at the time of deposition. All were buried shortly after the end of the Olduvai Event, ca. 1.77 Ma (Gabunia et al. 2000a; Lordkipandize et al. 2006).

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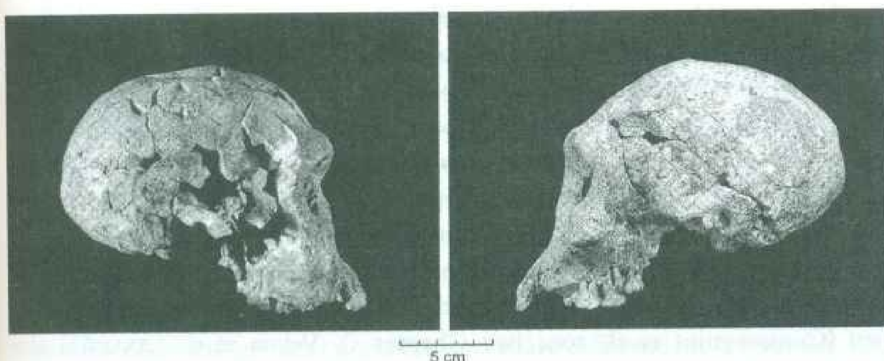


Figure 4.4. Cranial specimens KNM-ER 1813 (left) and D2700 (right) from Dmanisi.
Source: Rightmire et al. 2006, Figure 5.

I. CRANIAL AND DENTAL EVIDENCE

The first hominin discovery was a mandible (D211), found in 1991, which was important at the time in being the oldest of its kind from western Asia, but not otherwise particularly controversial. After comparing it to other specimens, notably from East Africa, China, and Java, Gabunia and Vekua (1995) concluded that it was probably best classified as belonging to an early population of *H. erectus* sensu lato, that is, including specimens from both Africa and Asia. As such, it was entirely compatible with the view that *H. erectus* originated in Africa and migrated across Asia ca. 1.7 Ma.

The discoveries of 1999 led to a substantially different conclusion (Gabunia et al. 2000a). The new finds were two crania (D2880 and D2882; see Figure 4.3) that came from the same level and area as the 1991 mandible. Both were largely complete, and D2882 retained most of its maxillary dentition. What was remarkable about them was their small size: the cranial capacity of D2880 was measured as 775 cm^3, and that of D2882 was estimated from measurements as only 650 cm^3. Despite their small cranial capacities, they were regarded as different from *H. habilis* and *H. rudolfensis*. Overall, the closest resemblances seemed to lie with the African early *H. ergaster*, rather than the East Asian *H. erectus* s.s.. As such, these new finds appeared to extend the geographic range of *H. ergaster* outside Africa and into Southwest Asia, as well as its morphological variability. According to Gabunia et al. (2000a:1025), the new evidence indicated that "these hominids may represent the species that initially dispersed from Africa and from which the Asian branch of *H. erectus* was derived". It was, in other words, a very early version of *H. ergaster*, as well as a putative ancestor of the East Asian *H. erectus.* Schwartz (2000), however, pointed out that the East African group of finds (KNM ER 992, 3773, 3883 and WT 15000) that were classified as *H. ergaster* formed an ill-assorted heterogenous group (see Chapter 2), and also suggested that the differences between D2880 and D2882 were such that two taxa were also likely to be represented. Given

A fossilized jawbone from Dmanisi

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sionally assigned this specimen to Homlo *ergaster*, they did so with greater caution than before, and also noted that "it can be argued that this population is closely related to *Homo habilis* (sensu stricto)".

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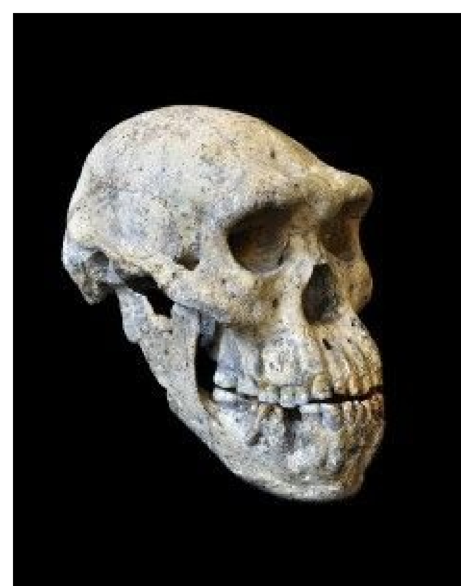
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15000) that were classified as H. *ergaster* formed an ill-assorted heterogenous group (see Chapter 2), and also suggested that the differences between D2880

and D2882 were such that two taxa were also likely to be represented. Given

Following the discovery in 2000 of a mandible (D2600) that is dated to 1.8 million years ago and was considerably more robust than the mandibular specimen D2II, Gabunia et al. proposed a new taxon, Homo *georgicus*. According to them: “ This species preserves several affinities with Homo *habilis* and Homo *rudolfensis*, and can be considered as one of their descendants, foretelling the emergence of Homo *ergaster*. It is close to the roots of the Homo branch and its presence indicates an early hominin diffusion from Africa towards Eurasia, between 2 and 1.8 million years ago, by the Levantine corridor” (10).



Skull D4500 (*Georgian National Museum*)

The proposal that the Dmanisi hominins belong to a new taxon, Homo *georgicus*, is at odds with the conclusions reached by Rightmire et al. (11). They propose that the Dmanisi crania are most appropriately classified as Homo *erectus* s.l.,but are also the most primitive types yet found, and suggest that the term Homo *erectus* goergicus is available to allow differentiation

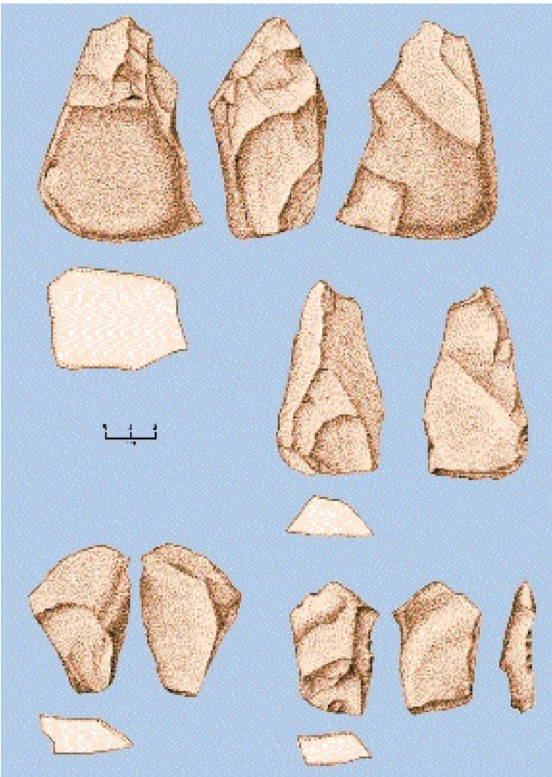
from the East African populations of Homo *erectus ergaster* and the Javan ones of Homo *erectus erectus*. The most provocative part of their analysis is their suggestion that the Dmanisi population may be ancestral to early Homo *erectus ergaster* in East Africa; as they state "Dating does not presently rule out the possibility that Homo erectus originated in Eurasia and that some groups then returned to Africa, where they evolved towards Homo erectus ergaster" (11). The implications of the suggestions that hominins left Africa before 1.8 million years ago and that Late Pliocene dispersals of hominins may have been both out of and into Africa, has also been suggested by Dennell (3).

The skulls, jawbones and fragments of limb bones discovered at Dmanisi suggest that our ancient human ancestors migrated out of Africa far earlier than previously thought and spent a long

evolutionary interlude in Eurasia - before moving back into Africa to complete the story of man. This is in line of what Dennel has been advocating on the evidence of artifacts he discovered in the Siwaliks of Pakistan, supported by the redating of fossils from the Far East. But has really excited the researchers is the discovery that these early humans (or hominins) are far more primitive-looking than the Homo *erectus* humans that were, until now,believed to be the first people to migrate oout of Africa about 1 million years ago. Furthermore, an analysis of a complete 1.8 million-year hominin skull, suggests to David Lordkipanidze (131) that the earliest Homo species - Homo *habilis*, Homo *erectus*, Homo *ergaster*, Homo *rudolfensis*, and so forth - actually belonged to the same evolving lineage - most likely Homo *erectus*. “The Dmanisi sample, which now comprises five crania, provides direct evidence for wide morphological variation within and among early Homo paleodemes. This implies the existence of a single evolving lineage of early Homo, with phylogeographic continuity across continents.” writes David Lordkipanidze (131). The finds at Dmanisi calls into question a widely held hypothesis that evolution of big brains propelled the exodus of earely humans out of Africa. More importantly, it questions African continent as the cradle of humanity.

Artifactual Evidence: Lumley et al. (36) provide a detailed account of the lithic assemblage excavated at Dmanisi between 199I and 1999. Some examples are shown in Figure below. The main types of stone used were volcanic tuff, basalt, rhyolite, granite, and quartz. One-third (33.8%) of the assemblage comprised unbroken pebbles, some of which were used as anvils, and a further 30-4% was broken pebbles and pebble fragments. If these are excluded, 10% of tools are described as pebble tools, mostly different kinds of chopping tools, and 5% as cores. Most (42.3%) were flaked on a single face, and 34.2% bifacially; multifac i a l s p e c i m e n s were rare (6.3%). Simple, unmodified flakes were very common (64% of the total tool assemblage, excluding whole and broken pebbles), and ca. one-third (31.3%) of these show some irregular retouch of their cutting edges, perhaps through heavy usage. The overall assessment of this assemblage is that the main objective of flaking was to obtain small, unmodified flakes, such as depicted in the followings.

In the analysts' view, the industry is best classified as "pre-Oldowan" because the types of retouched pieces evidenced in East Africa after 2.5 million years ago are so rare. Although at first sight it seems chronologically perverse for there to be a "pre-Oldowan" industry in the Caucasus that is 700,000 years younger than the earliest Oldowan


Simple pebble tools and flakes from Dmanisi

assemblages in East Africa, the exceptionally simple nature of the Dmanisi stone assemblage is consistent with the extremely primitive status of its makers (3).

Subsistence: At present little information is available on the subsistence behavior of the Dmanisi hominins. The most intriguing evidence is indirect, and concerns the edentulous skull and mandible specimens D3444/D3900. This individual had clearly survived without chewing hard foods - by relying on soft foods or by eating tougher foods that had been softened by the chewing of other individuals in the group. This is in turn implies a high degree of altruism and social cohesion. The presence of eight animal bones in layer BI with cut and percussion marks, as at contemporary East African sites, indicates that meat was obtained by defleshing carcasses with stone artifacts.

Evidence for plant usage is inconclusive. Thousands of seeds of Boraginaceae (e.g., *Anchusa, Lycopsis,* and *Lithospernum)* were found in the cultural layers (i.e., those with hominin remains and artifacts), as well as the seeds of hackberry *(Celtis).* The last-mentioned are reported from other hominin sites, such as Zhoukoudian, Lazaret, Terra Amata, and Tautavel. Gabunia et al. thus suggest that the Dmanisi hominins may have eaten seeds of *Celtis* and possibly also *Ephedra.* They also point out that Boraginaceae are often found in humanly disturbed habitats, and the Dmanisi horninins may therefore already have had an impact on the local vegetation. A note of caution is justified here, as hominins are not the only creatures to eat seeds or disturb vegetation. For example, fruits of *Lithospernum* and *Celtis* are present at the Early Pleistocene site of Akhalkalaki, where there is no evidence of hominins, so other animals have to be excluded before hominins are singled out as the main feeders on these plants (3).

SOUTHEAST ASIA AND INDONESIA



The countries of Southeast Asia cover over four million square kilometers, but in the context of studies of early humans, "Southeast Asia" means Java, as there is no evidence more than 800,000 years old from elsewhere in Indonesia,

or from the Southeast Asian mainland. If we assume that the earliest hominins in Java arrived there from or through South Asia, they would have first traversed the mouths of the Ganga and the silt plains of modern-day Bangladesh and then dispersed over 3,700 km through modern-day Myanmar (Burma), Thailand, Malaysia, and Sumatra. Java was then at the "uttermost end of the earth" for early hominins, as they did not venture any further south or east until some arrived on the island of Flores *ca*. 800,000 years ago. Java is most unlikely therefore to be representative of the early hominin record of mainland Southeast Asia, but until such evidence is found, it must suffice.

Southeast Asia is dominated by the Indian and East Asian monsoons, with heavy rainfall in summer, and a division between the two through modern-day Myanmar and Malaysia. Seasonal contrasts in temperature are greater in the northern part of this region, but are evened out in equatorial parts such as southern Malaysia and Sumatra. In equatorial parts such as Singapore, temperatures, humidity, and rainfall are high throughout the year, and only in Java is there a relatively dry season, during the summer. In the Early Pleistocene, the monsoon was often weaker than at present, so rainfall totals might have been more modest than today. Additionally, in the the Early Pleistocene world, when glacial and interglacial phases in northern latitudes alternated every 40,000 years or so, there would probably have been frequent vegetational shifts between closed and open conditions. Additionally, a large coastal shelf known as Sundaland linking Borneo, Java, and Sumatra with the mainland would have been exposed at roughly the same intervals during times flow level (see the map below). Java was probably colonized during one of these marine regressions.

Java: There are three main sets of information on Early Pleistocene Javan fossil hominids. The first is the skull cap, femora, and teeth collected by Dubois in the 1890s at Trinil, and which formed the type specimens of *Pithecanthropus erectus*. The second is specimens collected by in the 1930s by the Dutch Geological Survey at Sangiran and Mojokerto. The third set is material collected intermittently at Sangiran since Indonesia became independent. This includes two important Early Pleistocene finds, a severely crushed cranium, and four cranial fragments. The dating of all these specimens has proven extremely difficult, and opinions over when Java was first colonized have varied from *ca*. 1.8 million years ago to less than1.0 million years ago.

Problems of stratigraphic context: With the exception of Trinil and Ngangdong, there are major doubts over precisely where most Javan hominin specimens - particularly those from the 1930s - were discovered. One reason is that Koenigswald (and others) relied on collectors, or local people who were paid to find fossils, particularly of hominins. These collectors in turn often subcontracted to, or bought fossils from, local farmers. Jacob (37) noted that these collectors were often reluctant to reveal where they had found specimens in case they lost a potential source of income; additionally, they sometimes hoarded them in case their market value rose. In retrospect, the reliance on local fossil collectors proved to be a foolproof way of acquiring a poorly dated collection of fossil hominin remains without spending much money or doing much fieldwork (3). Sadly, many postIndependence specimens were found in the same way, by untrained local villagers, or during construction projects, rather than through systematic searching by trained scientists, as in East Africa and else- where. There are depressingly few detailed descriptions of precisely where original specimens were found, and their immediate geological context. In some cases, their probable - but not definiteoriginal geological context can be inferred; in other cases (notably Mojokerto), it has been possible to establish precisely where specimens were found by rechecking field notes and exposures, but lack of detailed contextual information (especially in the Sangiran Dome) is still a major impediment to establishing a secure chronological framework for many important specimens (3).



Location of early Pleistocene Javan fossil hominids mentioned in the text

How Old are the Early Pleistocene Javan Hominins: As noted above, the type specimen of Homo *erectus* from the Trinil is probably *ca*. 0.9-1.0 million years old, and Mojaverto is, at most, *ca.* 1.49 million years old. The most accurate chronological framework for dating the Early Pleistocene hominins from the Sangiran Dome is from Larick et al. (38), who have mapped one segment of the Sangiran profile and recorded the probable stratigraphic origin of 50 hominin remains, as well as volcanic samples that were analysed by Ar^{40}/Ar^{39} analyses of small bulk samples. As shown by these results, most hominins are *ca.* 1.3-1.1 million years old, which is close to earlier estimates. However, Larick et al. (38) point out that one specimen that lies at the top of the Sangiran Formation is 1.5 I ± 0.08 million years old, and is likely to be near 1.6 million years old. There are two recent 40 Ar/39 Ar assessments of the age of the Lower Lahar Unit that underlies the Sangiran Formation (3).

The Classification of the Javan Early Pleistocene Hominins: As noted above, the first discoveries at Trinil were named *Pithecanthropus erectus*. Those found in the I930s and I940s were given a variety of names. We need to bear in mind that this was an era of taxonomic splitting, and before 1939,

almost every new hominin discovery was given a different name.

At present, there are three main sets of opinion on the identification of the Javan specimens. The most parsimonious is that Homo *erectus* is found in East Asia as well as Africa. Others suspect that the African specimens are different from the Asian specimens, and thus Homo *erectus* denotes only the specimens from Java and China. A third, but less widely held view, is that the term Homo *erectus* has become a "dustbin" category that simply denotes any hominin in Asia before the Upper Pleistocene, and thus is in need of a thorough reassessment. There are two variants of this position. Some argued that the term should be dropped altogether, and all material classed as Homo *erectus* should be subsumed within Homo *sapiens* on the ground that the former has no unique traits not found in the latter (see the foregoing chapter). (Few have accepted this suggestion because it would give the creationists an opening for arguments in their favor). The second is that earlier workers may have been correct in recognizing an australopithecine or habiline component in the Sangiran sample, and thus not belonging to the genus Homo altogether. These suggestions are at serious odds with faunal evidence that indicates that the orangutan did not arrive in Java until the Upper Pleistocene Some have suggested that the earliest Sangiran specimens were derived from an early population of *Homo* that dispersed into Asia before 2 million years ago, rather than from the type of African Homo *erectus* seen at *ca*. 1.8-1.5 million years ago (3).

The Tool-making Activity of Early Pleistocene Homo Erectus in Java: Not surprisingly, the discovery of hominid fossils in Java in the 1930s prompted the search for the artifacts of Pithecanthropus erectus. In 1935, Koenigswald collected examples of flaked stone from the hilltop surface of a conglomerate at Kampong Ngebung, in the Sangiran area and attributed them to Pithecanthropus. Later that year, he also collected artifacts along a dry water course near Pajitan on the south coast of Java, as well as from a boulder conglomerate in the river bank. As the conglomerate was tilted, he thought it had to be at least as old as the strata at Trinil. The artifacts he collected included some he classed as Chellean handaxes; because of their crude appearance, he argued that the conglomerate from which they came must also have been very ancient. This material eventually became incorporated into Movius's scheme of East Asian "chopperchopping tool" industries, along with the Soan of Pakistan and the Anyathian of Burma. Later investigators argued that the artefacts from Sangiran and Pajitan were probably derived from much later contexts, and/or could not be associated with the hominin fossils. He also showed that the only true stone tools in the Sangiran area came from very recent gravel veneers capping the hills; as for the artifacts from Pajitan, they were probably late Pleistocene.

The lack of evidence for stone tools associated with early Homo *erectus* in Java has prompted suggestions that bamboo was preferred as a raw material. Yet the reasons that clear evidence for stone tools has not been reported from Early Pleistocene Java may be taphonomic. If, as suggested above, the hominin remains at Sangiran represent corpses that disarticulated as they drifted downstream, the areas where they lived, and probably used stone tools, were presumably upstream and outside the Sangiran area (36). As is well known, hominin fossils are not always found in the same areas as stone tools, even though their distributions may overlap. In addition, stone may not have been locally available. The Sangiran Formation consists largely of black clay, with numerous volcanic tuffs, deposited under estuarine and lacustrine conditions (3).



CHINA

The Early Paleolithic potential of this vast country has scarcely been tapped. For non-Chinese researchers, its Early Paleolithic record has been an ocean of darkness, illuminated by the occasional flickering of light from an

English-language research report and a few syntheses. Recent, high-quality research by Chinese scholars (often in collaboration with foreign researchers), published in English, in major scientific journals, has had a dramatic impact on our understanding of early Chinese prehistory, and the next decade is likely to produce some spectacular discoveries. At present, the lush and densely vegetated southern half of China has no clear evidence of hominins during the Early Pleistocene, unlike northern China, with which we begin. Figure below shows the main localities.

In North China, the first appearance of horninins now dates to ca. 1.66 million years ago at Majuangou III in the Nihewan Basin. Even earlier dates might be expected from Nihewan because much of the basin and the deposits underlying Majuangou III have not yet been fully explored. However, it needs to be stressed that the dating of these sites depends heavily upon estimates of

average sedimentation rates, and the assumption that sedimentation was continuous. These dates may change in the light of further detailed studies of the lake basin’s history (3).

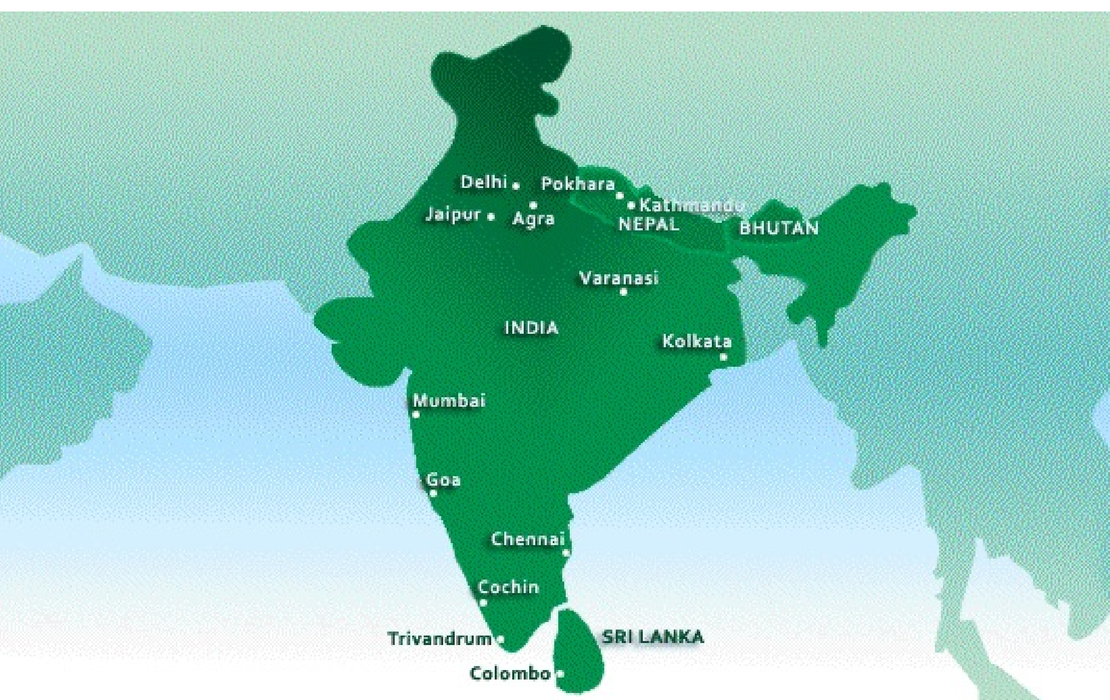
It is also likely that the northern limits of the Early Pleistocene hominins in North China expanded and contracted in response to the climatic shifts of the winter monsoon, so that they probably retreated southwards in cold periods. The assessment that "populations were able to occupy or shift their range over a considerable area, from Nihewan to the southern edge of the Loess Plateau, during a time of enhanced global and regional variability that included intermittent aridification of North China" (39) thus seems reasonable. On these grounds, the evidence from the Nihewan Basin is unlikely to represent a "core" population of horninins that was continually resident there throughout the Early Pleistocene, but one that was probably there intermittently, when conditions were favorable. Xiaochangliang, Xiantai, and Donggutuo now provides several sightings of hominins in the area before one million years ago. Evidence that hominins were present in South China before 1 million years ago is much less certain. Because of the uncertainties surrounding the evidence from Longgupo, Renzidong, and Yuanmou, there is as yet no convincing evidence that South China was occupied before 1.0 million years ago.

This discrepancy in the archaeological records of North and South China further implies that North China may have been colonized from Central Asia, via the "Tibetan corridor" between the Tienshan Mountains and the northern edge of the Tibetan Plateau, rather than from South China. This is not impossible: although this corridor is now largely desert, there would have been a feasible corridor between Central Asia and North China in the Late Pliocene and Early Pleistocene, when the northern edge of Tibet was lower than today. (As discussed elsewhere, most of Asia's deserts were probably a product of the Middle Pleistocene.) One implication of the suggestion that North China was colonized via Central Asia is that we *might* expect evidence similarly early as at Majuangou III to be found around extinct lakes in the loess grasslands of Central Asia, at the same latitude and in a comparable environmental and depositional context (3).

The earliest lithic assemblages from localities such as Majuangou, Xiaochangliang, Xiantai, and Donggutuo are technologically simple ones characterized by "the apparently uneconomical use of stone, the location of sites near large stone outcrops, the generally informal artifacts, and the rare occurrence of retouched flake and core platforms" (3). The irregular shape of most cores and flakes implies that lithic technology was highly expedient, with little foresight beyond the production of the next flake. Although the earliest Chinese lithic assemblages have been divided into a large-tool tradition and a small-tool one, inter-assemblage variation probably stems from the type and local availability of stone, taphonomic history, and on-site usage than different cultural traditions.

The taphonomic histories of the Nihewan Basin sites, and especially the fragmented nature of the faunal assemblages, impede investigations of the subsistence activities of these hominins. It is, however, evident that they were using (as at Ubeidiya and Dmanisi) lakeshore environments, and targeting areas with the requisite combination of stone, water, and prey. As at Ubeidiya and Dmanisi, there is no evidence of "camps" or structured spatial behavior in the areas they used; although some areas were used repeatedly, visits were probably brief and ephemeral (3).

INDIA and SRI LANKA



Although there has been much discussion of colonization and dispersal events in hominin evolution in South Asia, treatments in the literature have been geographically biased.

Most discussion has centered on the connections between East Africa, the Levant and East Asia, with little discussion of other major areas, including those situated along the Indian Ocean Rim, particularly Arabia, Iranian and Pakistani coastline, and coastal India. Unfortunately, the archeological record of South Asia has played little role in Out of Africa models, despite the central geographic position of the subcontinent in any potential southern dispersal route. In this regard, the goal of this chapter was to indicate the potential importance of the South Asian record through some working hypotheses, though the paucity of hominin remains and the chronological limitations of this record is recognized.

Robert Bruce Foote, an officer of the Geological Survey of India, is generally credited for the beginning of the study of the Indian Paleolithic, when he, in 1863, picked up a chipped hand axe at Pallaram near Madras. Foote went on to find and study many more stone tools and made major contributions to research on Indian Paleolithic prehistory. The Pallaram handaxe was not the first prehistoric tool discovered in India. In 1856, Le Mesurier, a railway engineer, had found a small chert arrowhead near Nyagurhee village in central India. Prehistoric tools were subsequently reported from many areas including the eastern Vindhyas, the Jabalpur area, the Andaman islands, and Bengal. The geologists who played a major role in these discoveries shared their evidence and ideas with European geologists such as Charles Lyell and archaeologists such as J. D. Evans. In 1868, Foote travelled to England to inform the scholarly community about his work, and in 1873, some of the prehistoric tools he had discovered in India were displayed at the International Exhibition held at Vienna. Since the 19th century, hundreds of prehistoric sites have been identified in the Indian subcontinent and new methodologies and persptives have enhanced our understanding of the stone age.

Hominin Remains: In sharp contrast to the widespread occurrence of animal fossils and stone tools all over the subcontinent, the evidence of hominid fossils is at present very meagre. This is no doubt due to inadequate investigations.

From the 19th century onwards, several remains of fossil apes were discovered in the Siwalik hills, the outermost range of the Himalayas. Given rather dramatic names such as Ramapithecus, Sivapithecus, and Brahmapithecus, they came to be collectively known as the 'God-Apes of the Siwaliks'. Remains of Ramapithecus were subsequently found in other parts of Asia, Africa, and Europe as well, and were dated between 10-14 million years ago. Ramapithecus, who lived in the Miocene-Pliocene transition, was once thought to represent the oldest direct ancestor of modern humans. However, this has been questioned on the basis of new dating methods and a reassessment of the fossil evidence.

More recently, hominin fossils have been found in central India. In 1982, Arun Sonakia of the Geological Survey of India made an important discovery near Hathnora village on the northern bank of the Narmada, about 40 km north-east of Hoshangabad. Here, embedded in thick, closely packed sandy, pebbly gravel he found a fossilized frag- ment of a cranium (skull cap) along with some fossils of vertebrates *(proboscideans* and *bovids)* and a few late Acheulian tools. The skull fragment seems to have belonged to a woman about 30 years old. Sonakia suggested that she represented an advanced variety of *Homo erectus* -'advanced' because of her larger cranial capacity range of 1155 to 1421 cc and named her *Homo erectus narmadensis*. However, according to other scholars, the cranium belongs to an early (archaic) variety of *Homo sapiens*. Its date too is uncertain. One view is that it belongs to the early part of the middle Pleistocene, beginning about 500,000 years ago but the consensus is on ca. 350,000 years ago or near about.

Between 1983 and 1992, the Anthropological Survey of India launched an intensive search for human fossils and tools in the central Narmada valley. This led to the discovery of hundreds of paleolithic tools and some animal fossils In 1997, A. R. Sankhyan announced important discoveries in the same boulder conglomerate deposit at Hathnora where the cranial fragment had been found some years earlier. These included a hominid clavicle (collar bone) along with animal fossils and several lale or middle paleolithic tools. Estimated dates of these finds range between 0.5 to 0.2 million years ago. Sankhyan suggested that the two sets of human fossils found at Hathnora may well belong to the same woman.

In 2001, Rajendran, a teacher in the Department of History of Kerala University, found a complete fossilized human baby skull in Odai in the Villupuram district of Tamil Nadu. Rajendran was excavating a trench which had microliths in the upper levels and upper paleolithic tools at the lower ones. At a depth of 6 m, just under the upper paleolithic deposit, there was a ferricrete deposit (a mineral conglomerate consisting sand and gravel, cemented into a hard mass by iron oxide) The skull was found close to this trench, embedded in a similar ferricrete deposit which was later dated 166,000 years ago, placing it in the middle or upper Pleistocene.

The antiquity of certain other reported hominid finds is uncertain. This is the case of H. D. Sankalia and S. N. Rajaguru on the bank of the Mula-Mutha river in Pune district, Maharashtra. The age of the mandible of an adult male found by V S. Wakankar in a cave at Bhimbetka in Madhya Pradesh is similarly uncertain. Only a very miniscule proportion of the hominid record of the Indian subcontinent has so far been discovered. More concerted efforts are likely to add to the data and may transform the larger story of human evolution, which has so far concentrated more on Africa and Europe than on South Asia.

Stone Artifacts and their Distribution: Palaeolithic tools have been found in almost all parts of the

subcontinent. Although hardly any sites have so far been discovered in the alluvial stretches of the Ganga valley, they have been identified on rocky areas within or on the margins of this valley, and the northern fringes of the Vindhyas. Sites are prolific in other parts of India, especially in peninsular India, leaving aside the coastal plains. Comparatively few paleolithic habitation sites have been identified, but it can be assumed that people lived close to sources of food, water, and stone in different kinds of habitats - for instance, along the banks of rivers or streams and in caves and rock shelters.

Excavated sites are few and most of the evidence comes from surface finds of stone tools. Because of insufficient data from most sites, it is necessary to focus on the published results of stone tools found in clearly defined stratigraphic contexts. Even in the absence of detailed studies, some broad inferences about Pleistocene climate can be made on the basis of the deposits in which paleolithic tools are found. For instance, tools often get embedded in river terraces. Although a number of other factors are also involved, the erosion and deposition activity of rivers can be related to rainfall. Cemented gravel (a deposit in which small pebbles are packed tightly together in soil) is generally taken to represent a wet climatic phase. A boulder conglomerate (a deposit where larger boulders are packed together) is interpreted as representing a drier phase, while clay or silt deposits represent still drier conditions.

Early paleolithic tools were fairly large core tools made of quartzite or other hardrocks. They include chopping tools, handaxes, and cleavers. Apart from directly breaking off pieces of stone from large boulders, which would have required considerable strength, it is possible that people lit fires against rocks and threw water over them so that large fragments broke off more easily. Within the paleolithic, there is a gradual increase in the range and variety of stone tools and a shift in preference from coarse- grained to fine-grained stone.

Some absolute dates are now available for lower paleolithic contexts. Didwana in Rajasthan has been dated 390,000 years ago (by the uranium/ thorium series dating method). In the Hiran valley in Gujarat, the lower paleolithic context is dated 190,000-69,000 years ago (via the uranium/thorium series dating method). For the Son valley (MP), there is a thermoluminescence date of 103,800 ± 19,800 years ago Nevasa (in Maharashtra) has given a date of 350,000 years ago (via uranium/ thorium series dating). In Karnataka, the site of Yedurwadi has been dated 350,000 years ago. These dates are considerably younger than those reported from Pothwar in Pakistan .

A systematic study of stone age sites in south Delhi and adjoining areas identified 43 sites ranging from the lower paleolithic to the microlithic. Excavations at Anangpur in the Badarpur hills to the south of the city revealed thousands of early and late Acheulian tools along with traces of several paleo-channels of the Yamuna river. The evidence indicates that this was a large lower paleolithic habitation and factory site. In Rajasthan, lower, middle, and upper paleolithic toolshave been found around Ajmer and stray finds of lower paleolithic tools occur in the Luni valley. The Mogara hill near Jodhpur seems to have been a factory site where lower, middle, and upper paleolithic as well as mesolithic tools were made. Dates of these cultural stages are, however, not available.

In the Belan valley in Uttar Pradesh, detailed studies have revealed a sequence of stone age industries from the lower paleolithic to neolithic to protohistoric. In Bihar in eastern India, a lower paleolithic living and working floor was excavated at Paisra **in** the Kharakpur forests near Munger. The whole area was rich in finished and unfinished artifacts, broken pieces of stone, and anvils. Eight post-holes

were found, marking places where wooden posts had been dug into the ground to sup- port thatched huts. Again, dates are not available .

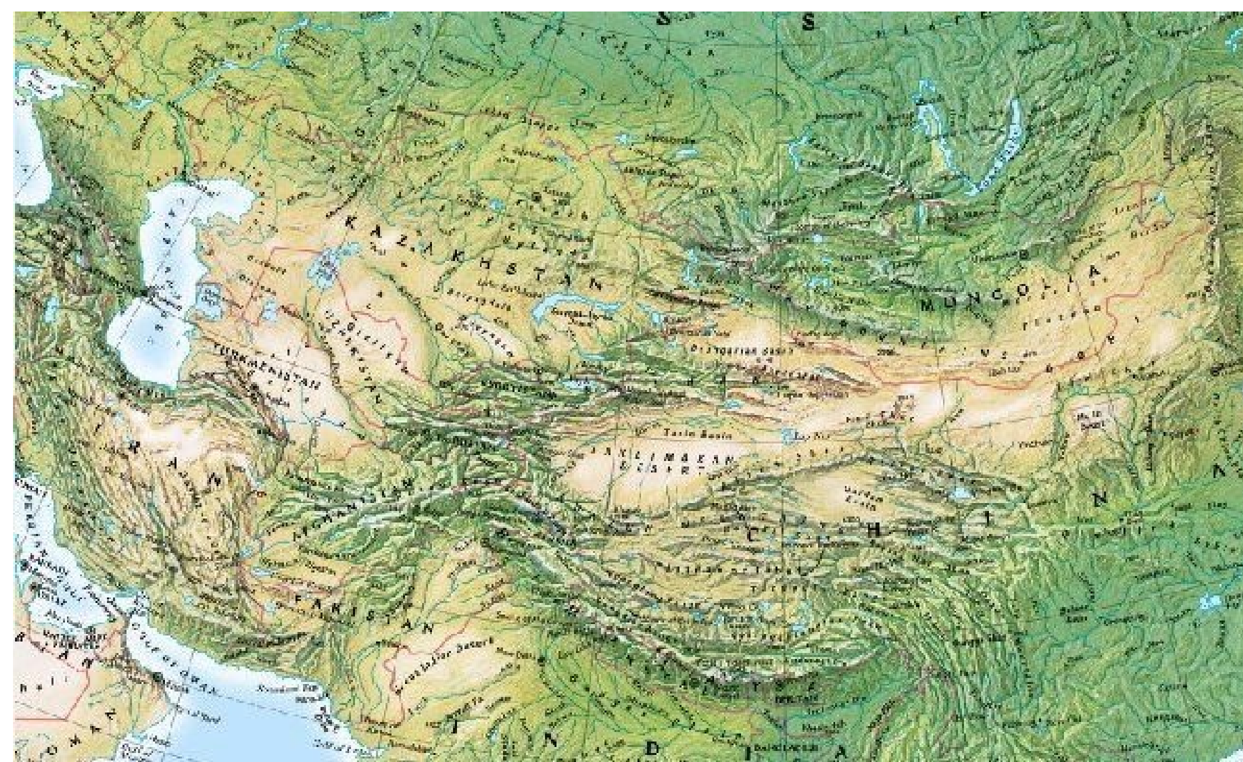
At one time, it was believed that the lower palaeolithic industry of the south (which was given the name 'Madrasian') was different from that of other parts of the country because of a supposed absence of pebble tools. The research of the past few decades has proved that this is incorrect, and that pebble tools such as choppers and chopping tools are found along with handaxes at several sites. These are, however, not common.

In agreement with Dennell (13), it may be argued that the rarity of Mode 1 occurrences in South Asia indicates a sporadic or non-permanent occupation of the subcontinent. So far the most credible evidence for an early occupation comes from Riwat in the Pothwar region but this evidence is not corroborated by any other Mode 1 site in the whole of South Asia. Although further work may detail the presence of Mode 1 sites, it is unlikely that the evidence will ever be construed as a permanent and continuous occupation by Pliocene and Early Pleistocene hominids (205). The reasons for the scarcity of Mode I sites to emerge in the subcontinent is not at all clear, as early hominins probably had the ability to penetrate the region and favorable environments were present. One possibility is that the vast deserts acted as a barrier and the lack of workable stone was detrimental to tool-dependent dispersing populations (209).

On the other hand, Acheulean occupation of South Asia is certain and it is linked to at least one dispersal event from the West (205). Based on chronometric evidence, it is difficult to determine if Acheulean hominins were present in the subcontinent prior to 1 million years ago. More secure evidence indicates a dispersal into the subcontinent after 700,000 years probably accounting for the high frequency of well-made Acheulean tool forms and advanced preparatory techniques in toolmaking. Such chronological and technological evidence would coincide with the presence of Homo heidelbergensis in India. However, given that the Narmada specimen shares many attributes with Homo *erectus* (210), the presence of this species, or more than one archaic hominin population in South Asia cannot be discounted (205).

Basedontheknowndistributionof Acheulean sites in South Asia, hominin populations appear to have occupied many basins within peninsular India and in valleys of the sub Himalayan zone. While the Acheulean evidence in South Asia supports the survival of hominin populations in the region over hundreds of thousands of years, the record does not necessarily indicate that populations were large and permanent in any one region. Rather, Acheulean populations may have been small and dispersing between various basins within the subcontinent. All these findings are interesting but without dating they are of little value to the student of prehistory. They do tell us the progression of technology but do not give us the answer to the question of when.

CENTRAL ASIA, AFGHANISTAN, AND IRAN



Central Asia has played an important role in Palleolithic archeology of Pakistan since the discovery of Teshik-Tash in 1938. Since the 1970s, attention has turned to

Lower Paleolithic studies following the important discoveries at Kuldara and other deeply stratified loess sites in southern Tajikistan. The sites, dated to as early as 800,000 years ago, are not the earliest evidence of hominins in Asia, but they do reflect early adaptations to arid mid-latitude environments. The stone-tool industries from these early sites are composed of pebble and flake implements; they do not include bifaces. Along with the archeological material in the loess is an impressive paleoenvironmental record with good chronological control. In other parts of Central Asia, there are reported elements of the Acheulean technocomplex at sites such as Sel'ungur and Yangadazha, but that claim cannot be substantiated. In the Upper Pleistocene, important research questions include the extent and meaning of Middle Paleolithic variability, the relation of Middle to Upper Paleolithic cultures, and the effect of glacial or interglacial climatic oscillations on Paleolithic settlement and adaptation.

The Lower Paleolithic of Central Asia is represented by several sealed and more or less firmly dated Lower–Middle Pleistocene cave and open-air sites in the southeastern part and by more numerous surface occurrences throughout the region. The assemblages assigned to the Lower Paleolithic form two rather distinct groups, one remarkable for wellmade handaxes and the other characterized by cores and flakes with no handaxes. The distribution map of pebble industries and industries with handaxes shows that while the latter originate from the western regions of Central Asia, the former are concentrated in the eastern part of the area. The Middle Paleolithic assemblages of Central Asia do not form a single technocomplex. Their variability in time is difficult to assess, but variation in space is obvious. Very few Upper Paleolithic sites in this region are known. At the same time, their stone industries are very diverse and most of them differ sharply from each other and from sites in adjacent regions

Authenticated early human remains in central Asia are relatively recent. In 1966, Louis Dupree discovered a fragment *of* right temporal bone at the cave site of Darra-i-Kur in north-eastern

Afghanistan. The deposit in which it was found gave a radiocarbon date of 30,000 ± 1900-1200 years ago. The fragment was considered consistent with Neanderthals as well as anatomically modern humans. The associated stone tools seem to belong to a middle paleolithic context.

One intriguing study was by Ariai and Thibault, who reported stone artifacts from a series of sections along the edge of an alluvial basin that contained a large but probably shallow lake at Kashafrud,40-80 km east of Meshad in Iran and near the border with Afghanistan. They reported quartz "pebble tools" on the surface (level I) and at the base of a gravel layer (level 3) at Abravan. Four others were reported from within layer 3 at another section, at Baghbaghu. There is at present no way of knowing the age of these deposits or the stonetools. According to a recent study, some of the items from Kashafrud are geofacts, but the remainder are similar to East African Oldowan ones and also to the tools from Dmanisi. The suggested Early Pleistocene date is thus reasonable, especially given other lakes of this age in Saudi Arabia and Israel, and the evidence that the Aral and Caspian Seas were conjoined in the Early Pleistocene. Because of the evident dearth of research in central Asia, Iran and Afghanistan, this area sheds little light on the colonization of this area in the Early and Middle Pleistocene. Not only are fossil hominids are absent but also the stone artifacts are poorly recorded.
PAKISTAN



stan were colonized Pakistan sits in the middle of Asia and by logic it is not possible that this area was somehow devoid of any human presence. In fact, the lithic evidence from Pothwar in the north of Punjab shows that at

least some parts of Pakiby early humans or their predecessors as early as 2 million years ago, namely in the late Pliocene and early Pleistocene. It is, however, unfortunate that in the discussions of colonization of South Asia the evidence from Pothwar is only mentioned tangentially, if at all. This evidence is, nevertheless, vital as it bridges the archaeological gap that exists between the evidence from Caucasus and West Asia. We shall take up this topic in a separate chapter in some details; here we want to touch upon a few points to round off the discussion on the earliest inhabitants of Asia. In this context there are two important early paleolithic sites in Pakistan that need to be mentioned at the very outset: Riwat and Pubbi Hills in the Pothwar region.

Riwat: A small assemblage of flaked artifacts was found at Riwat in a Late Pliocene context in the Soan Valley, Pothwar (40), which were dated through paleoimantometry and Potassium/Argon technique to 1.77-1.95 million years ago. The principal discovery at Riwat was a piece of flaked quartzite protruding from a cemented gritstone/ conglomerate near the base of a 70 meter deep gully. It showed little evidence of rolling or abrasion, and had been flakes eight or nine times in three directions; flake scars and ripple marks were clear, and some flakes showed a bulb of percussion at

the point of impact. In other words, it had all the characteristics one would expect of an intentionally flakes stone. Further inspection of large blocks that had become detached from the gritstone horizon produced twenty-three pieces that showed evidence of flaking; of these four were regarded as intentionally struck (3).

The obvious limitations of the Riwat evidence are that the stone artifact assemblage is very small; there is no associated faunal material; and they were not found in their primary context. Nevertheless, the flaked pieces are convincing as artifacts; they were found in securely dated geological context, and they are therefore Late Pliocene in age. The evidence is also consistent with what would be expected of hominins in a landscape where stone was scarce.

The Pabbi Hills: The Pubbi Hills are a low anticline ca. 8 km wide and 40 km long between Islamabad and Lahore that is formed of sands, silts, and clays laiud down by an ancestor of the modern River Jhelum which lies 3 km yo its northwest. The oldest deposits are *ca*. 3.5 million years old, and the youngest only 0.5 million years old, which thus makes the Pabbi Hilla one of the youngest anticlines in the world. Deposition was cyclical, with an average of 30,000-50,000 years, and each cycle of, sands, silts, and clays was capped by a sandstone. Because of uplift and their greater resistance to erosion, these sandstones are often ridge-forming and useful marker horizon.

In 1980s, the members of the British Archaeological Mission collected several thousand vertebrate fossils, mainly of medium to large mammals from exposure between 2.2 and 0.9 million years ago (41). A large number of flaked stones were also recovered, some of them were considered to be artifacts. Most of these were simple cores and flakes (42). Establishing the age of this material proved frustratingly difficult, as no pieces were found in secure context. This is inevitably difficult when working in an area of actively eroding soft sediments, where the chance of finding an isolated piece of flaked stone protruding from a layer of sand or silt are remote, and even then, it would be hard to disprove that it had been recently trodden in. The matter, therefore, stands that these artifacts were most likely laid between 0.90 and 2.2 million years ago and are nominally *ca.* one million years old.

The wealth of the earliest Paleolithic evidence in Pakistan is not matched by finds of the artifact manufacturers themselves. Like India, no human fossil record is available from Pakistan and it is not certain who fabricated these stone tools: in this timeframe Homo *habilis* is not known to be present anywhere in Asia and the date is too early for the presence of Homo *erectus.* This leaves Australopethicus, a non-human creature who is known to chip stones and using them as tools. But here also, there is no evidence that Australopithecus ever left Africa to spread in Eurasia. Robin Dennell (3) has studied this dilemma and we shall discuss his conclusions in the Section III. The dearth of Pleistocene hominin fossils in Pakistan has been sometimes viewed as a product of survey intensity. Yet, as demonstrated by Dennell, the mammalian fauna in the Pabbi Hills is biased in favor of the recovery of animals that are larger than humans, indicating that identifiable hominin fossils would be rare finds.

Although Pakistan is in a central position in Eurasia, it is unclear how this landmass was traversed by hominin populations when they came to inhabit this region. Whatever routes were chosen, predictions are that the early paleolithic sites will likely remain relatively rare even if additional and focused surveys are performed. Though early hominins have been viewed as successful colonizers once they dispersed out of Africa (120), Dennell (121) has argued that this may not have been the case all the time. In this view, the handful of Late Pliocene and Early Pleistocene localities indicate that hominin

occupations were not permanent and always successful. This would be in line with the nature of the South Asian evidence in general.

Late Middle Pleistocene sites in the subcontinent indicate a technological change from the manufacture of large cutting tools to core and flake technologies of the Middle Paleolithic. This technological transition has been described as a profound adaptive change, as hominins supplemented handheld implements with hafted technologies (60). A number of sites in the Pothwar region indicate that the transition from Acheulean technology to core and flake technologies occurred gradually. No development sequence has yet been formulated at any of these sites. If such a local sequence from the Lower to Middle Paleolithic could be developed it would imply technological convergence and independent transitions amongst different continents rather than development of prepared core technology in Africa, and a subsequent technological spread to other areas, including South Asia. This is an important point as so many archaeologists have followed such a sequence or parallelism and this has lead us to nowhere in deciphering the cultural change in this region.

While the presence of modern man in South Asia during 50,000-70,000 years ago is strongly indicated through genetic research(see Section IV) and change in tool-making technology, there is no accelerated cultural change in this region as it is evident in Europe *ca.* 35,000 years ago. There is, no technological revolution in sight, there is no hiatus in tool types, there is no clear reduction in tool frequencies, and there is no sign of a ‘great leap forward’ as is generally portrayed for Europe. In this respect, therefore, the corresponding time period is essentially a non-event in Pakistan and the surrounding region of Iran, Afghanistan and India. We shall come to this topic again.

OPENING THE PANDORA’S BOX - AN ASIAN PERSPECTIVE

The re-dating of strata that have produced hominin remains at Sangiran and Modjokerto to 1.6-1.8 million years ago, the discovery of stone tools in Pothwar in Pakistan that may go back to 1.9-2.1 million years ago, and the turning up human fossils in Caucasus that are at least 1.8 million years old, opens up an entirely new Pandora's box of diversity of hominins in Asia. In all of these regions, and probably also in China, we have specimens from the same time and place possibly representing several very different grades or clades of hominins - apparently at least three and possibly four distinct hominin lineages in Asia at or near the Plio-Pleistocene boundary. This conclusion is in sharp contrast to the earlier and almost universally accepted story wherein the specimens dated to the earliest Pleistocene have long been recognized as well-evolved forms of Homo *erectus*, the latter being related to Homo *ergaste*r in Africa.

If, for the sake of argument, we accept all of the above evidence as representing valid PlioPleistocene Asian hominins, and there seems to be a much greater willingness to do so now than in the recent past, what do we get? What does this apparent diversity say about hominin dispersal patterns in Asia? It would seem, for one, that it would not have taken much for hominins to have made their way from Africa to the far reaches of East Asia and Sundaland during the early Pleistocene. It should not come as a surprise: other primates have had little difficulty in dispersing throughout Africa, Europe and Asia, where their remains are found in deposits that date from the early Miocene to the middle Pliocene, so why should early hominins have been any different? Given the success of their progeny, it could be argued that they were very hardy creatures, perfectly capable of meeting whatever environmental challenges they may have encountered on their trek to the Far East. Moreover, it could be argued that various early hominin lineages dispersed soon after their first appearance, suggesting

that some later lineages may have diverged in Asia rather than Africa. Thus the possibility has been raised that Homo *erectus* actually evolved in Asia from a species of early *Homo*, perhaps returning to Africa fully formed and ready to smite its more primitive brethren, the *australopithecines* or Homo *ergaster*. The prospect of multiple hominin species spreading far and wide during the early Quaternary fits well with the perspective that sees hominins as no less prone to rapid and frequent speciation than any other mammalian group (12).

If we accept the above scenario, the early Quaternary landscape of Asia would have been replete with a dazzling array of hominoids. Again, if we accept the argument that hominins were able to disperse so quickly after their first appearance on the evolutionary scene we may have to cast our nets much further afield when looking for potential human ancestors than previously assumed.

The past three or four decades have seen the Pliocene and Pleistocene fossil hominin record enriched by the addition of at least ten new taxa, including the early Pleistocene, small-brained hominins from Dmanisi, Georgia, and the diminutive Late Pleistocene Homo *floresiensis* from Flores, Indonesia. At the same time, Asia's earliest hominin presence has been extended up to 1.8 million years ago, hundreds of thousands of years earlier than previously envisaged. Nevertheless, the preferred explanation for the first appearance of hominins outside Africa has remained virtually unchanged. Robin Dennel, through his many writings and field work, has shown that it is time to develop alternatives to one of palaeoanthropology's most basic paradigms: the 'Out of Africa1'. He offers some tantalizing thoughts as he observes the human evolution from Asian perspective. We conclude this chapter with a partial recanting of one of his thoughtprovoking article "*An Asian perspective on early human dispersal from Africa* (20).

A key assumption in accounts of early hominin evolution is that the genus Homo originated in Africa, and an early form, classified either as Homo *ergaster* or H. *erectus sensu lato*, was the first to leave about 1.7–1.9 million years ago (depending upon one's choice of dates and specimens), and then colonized southern Asia as far as 40^{o} N. The identification of east Africa as the 'core' area for the genus Homo (including H. *ergaster*) as well as tool-making seems secure to most palaeoanthropologists, and the most recent attempts at modeling early hominin dispersals start implicitly from the assumption that H. *ergaster* originated in east Africa and then dispersed across Asia. In fact, the evidence that H. *ergaster* originated in east Africa is less convincing than it seems. H. *ergaster* marks such a radical departure from previous forms of Homo (such as Homo *habilis*) in its height, reduced sexual dimorphism, long limbs and modern body proportions that it is hard at present to identify its immediate ancestry in east Africa. Not for nothing has it been described as a hominin "without an ancestor, without a clear past" (123).

We may also repeat the conclusion, which David Lordkipanidze has reached after analyzing a recently discovered complete skull at Dminisi: "The Dmanisi sample, which now comprises five crania, provides direct evidence for wide morphological variation within and among early Homo paleodemes. This implies the existence of a single evolving lineage of early Homo, with phylogeographic continuity across continents." (145). These concluding remarks contradicts the "Out of Africa" hypothesis, which proposes that Homo *erectus* evolved in Asia and stayed there, as part of an evolutionary sideshow and that it had no bearing on the origins of later *Homo sapiens*.

Who were the first Asians? "At present, we have very little information on where, when and which hominins first appeared in Asia, and the expansion of Homo *ergaster* across Asia in the Early

Pleistocene remains a massive assumption, even if it is routinely treated as a historical fact. It is assumed that it migrated out of Africa along the Nile Valley or across the southern end of the Red Sea, but there is no archaeological or fossil hominin evidence that hominins were in the Nile Valley in the Lower Pleistocene; and there are no Oldowan sites in the Sinai, southern Negev, or in southwest Arabia at the alleged point of entry to Asia. The only Asian Early Pleistocene fossil hominin evidence comprises three incisors from 'Ubeidiya, Israel (1.4–1.0 million years ago), attributed to Homo *erectus sensu lato* (s.l.) by default (124); the 1.8 million years old specimens from Dmanisi, Georgia, which have recently been classified as a very early type of Homo *ergaster* and/or a new taxon, Homo *Georgicus*; and the specimens attributed to Homo *erectus sensu stricto* (s.s.) in Java, 5,300 miles away and regarded by many but not all as different from the east African Homo *ergaster*. The earliest of these is the Mojokerto cranium, which now seems to have been found in context, despite previous misgivings, and is dated to 1.81 Million years ago; the key specimens from Sangiran have been dated to about 1.6-1.7 million years ago. This meagre list of sites is supplemented by archaeological instances of Early Pleistocene artifacts in Asia that are attributed to Homo *erectus s.l.*; examples are Erq el-Ahmar, Israel, claimed to date to the Olduvai Event, and the Nihewan basin, north China. The artifacts from Riwat, dating around 2 million years ago, are also in the same category. The only reason why the earliest tool assemblages in Asia are attributed to Homo *erectus s.l.* is that palaeoanthropologists have already decided that, in effect, it was the only hominin capable of migration out of Africa, and with sufficient Wanderlust to do so" (20).

Homo *ergaster*: Wanderer or Stay-at-Home Body? The reason why Homo *ergaster* is assumed to have been uniquely capable of migrating out of Africa about 1.7-1.9 million years ago into the Asian grasslands is because of its long limbs, human-like body proportions, probable efficient thermoregulatory mechanisms for remaining cool in hot conditions, the ability to ingest large amounts of meat in an environment rich in plant foods for a hungary primate, and sufficiently large brain to deal with the challenges of a more carnivorous niche. This argument is persuasive, except for the point that australopithecines had probably colonized all the African savannah grasslands by 3.0-3.5 million years ago, and Australopithecus *garhi* was living in a similar environment in north-east Africa by 2.5 million years ago. As savannah grasslands were extensive across southern Asia by 3.0 million years ago, there are no reason a priori why australopithecines could not also have expanded into the Asia grasslands before Homo *ergaster.*

The fossil evidence that Homo *ergaster* was in Asia in the Early Pleistocene is not only weak, but extremely ambiguous.The long-running debate over whether the Early Pleistocene Javan hominins should be classified as Homo *erectus s.s*. (and thus different from their east African counterparts) or incorporated with them as Homo *erectus s.l*., and/or seen as composite is still unresolved. Neither those who regard them as an integral part of Homo *erectus s.l.* nor those who view them as derived from the African Homo *ergaster* question that the core area was east Africa. Neither position is strengthened by the recent suggestion that the Mojokerto child had an ape-like pattern of postnatal development, unlike Homo *ergaster*. Another 'big unknown' is the ancestral form of the Late Pleistocene Homo *floresiensis*, which may prove to have roots deep in the Asian Pleistocene. The Dmanisi hominins are harder still to assimilate within a simple model of African origin and Asian dispersal by Homo *ergaster* or H. *erectus* s.l. The first discovery, of the mandible, could be classified as Homo *erectus* s.l. The first crania were regarded as a very early form of Homo *ergaster*, and the latest, very small-brained one (D2700) as Homo *ergaster* but also closely related to Homo *habilis* s.s. Confusingly, one mandible (D2600) has been assigned to a new taxon, Homo *georgicus*. These recent assessments imply that hominins dispersed from Africa earlier than the emergence of large-bodied

hominins such as the Nariokotome individual (20).

When Could Hominins First have Left Africa? On the basis of his analysis of Dmanisi fossil skulls and noticing their particularly small brian sizes, David Lordkipanidze (145) implies that he was looking at the crania of a very primitive creature, prior to Homo erectus, probably Homo *habilis*. Dennell asks: if a hominin at the same grade as Homo *habilis* was able to exist Africa, why not others? Why not follow the logic of Wood and Collard's reasoning (125) that Homo *habilis* is better classified as A. *habilis* and suggest that the earliest Asians were in fact australopithecine, with A. *georgicus* as their first known representative outside Africa? This suggestion would open a Pandora's box: if a hominin as small-brained (and probably as short) as those at Dmanisi could colonize southwest Asia by 1.7 million years ago (and with no obvious African antecedents), why not at 2.6 Million years ago, shortly after stone tool making became part of the hominin repertoire? Or why not even earlier, by, for example, 3.0–3.5 million years ago, when the Saharan–Arabian desert barriers did not yet exist? If *A. bahrelghazali*, 2,500 km west of the Rift Valley, implies that by 3.5 Million years ago "hominids were distributed throughout the woodland and savannah belt from the Atlantic Ocean across the Sahel through eastern Africa to the Cape of Good Hope", why could they not have done the same across the grasslands of western, southern and central Asia? (20).

Absence of evidence and evidence of absence: The obvious retort to these questions is that there is no evidence that australopithecines did migrate out of Africa. However, absence of evidence is not enough; we need convincing evidence (so far not forthcoming) that the absence is not the result of taphonomic circumstance or lack of fieldwork, especially in a continent as large as Asia. There are only a limited number of vertebrate fossil assemblages for the Late Pliocene and Early Pleistocene of southwest Asia (a region larger than Kenya, Ethiopia and Tanzania combined). The Late Pliocene assemblage from Bethlehem (Israel) is very small, with only 11 taxa and dominated by animals with an adult body weight of more than 60 kg and thus larger than hominins. These fossils were found in coarse gravel (with clasts up to 0.5 m long) in a clay matrix, in which small and fragile remains were most unlikely to be preserved. At Kvabebi, Georgia, dated to more than 2.6 million years ago (that is, earlier than the earliest stone tools in Africa), there are 21 mammalian taxa indicative of a riverine and marshy environment. Two other Georgian localities, Kocachuri and Calka, are slightly earlier than Dmanisi and yielded small assemblages dominated by large taxa. There are 21 taxa represented at Dmanisi, and 33 (excluding microfauna) at 'Ubeidiya. The point here is that small assemblages, with only a few taxa that are mainly from large animals, are most unlikely to contain hominin remains: in southwest Asia, two of the three large and fine-grained assemblages did yield skeletal evidence of hominins (although very little at 'Ubeidiya). In central Asia, the Late Pliocene record is poor because fossils are often found in coarse sediments, although one surprising find is of the baboon that is often regarded as a commensal of Homo (20).

LatePliocenefaunalassemblagesfrom northern Pakistan and India do not contain any hominins, and these are also unknown for the entire Early Pleistocene: the earliest fossil hominin evidence we have is Middle Pleistocene, from the Narmada Valley, long after hominins are first in evidence to both the west and east of the Indian subcontinent. Although many vertebrate taxa are represented in the Upper Siwaliks of India and Pakistan (30 in the Tatrot and 49 in the succeeding Pinjor

Asia might not have been the passive recipient of whatever migrated out of Africa but might have been a major donor to speciation events, as well
as dispersals back into Africa. Such two-way traffic is well documented for other mammals in the

Pliocene and Early Pleistocene, such as Equus and bovids, with more taxa migrating into than out of Africa.

Stage in Pakistan), most are larger than hominins. It is also likely that the full range of taxa is incomplete for the Indian subcontinent, because *Megantereon* and *Pachycrocuta* are not recorded in India but are present in Pakistan; in Pakistan, there is no evidence of *Camelus* and small primates, and in neither country is *Homotherium* recorded, although this is present to the west at Dmanisi, to the north at Kuruksay, Central Asia and to the east at Longuppo, south China. In mainland southeast Asia, there is no Late Pliocene or Early Pleistocene fossil evidence. One of the few instances for which we can be reasonably sure that Homo *erectus* s.l. (and other hominins) were absent is Longuppo, south China, where four primates are recorded among the 68 taxa present. The faunal assemblages from the Yushe Basin and the "Hipparion fauna" of north China are of comparable quality to those from India, and the absence of hominins is equivocal. (20).

Waysforward:alternativestoOut-ofAfrica 1: If the above taphonomic review suggests that we cannot show the absence of hominins from areas in Asia at a time before the little evidence we have indicates their presence, we need to consider alternatives to the current Out-of-Africa model. There are three issues here. The first is when hominin(s) first left Africa - might they, for example, have left shortly after they acquired the ability to make stone tools, the earliest of which are currently 2.6 million years old? Or could they have left even earlier, about 3.0–3.5 million years ago, when some australopithecines were already living in the African grasslands? The second issue is whether we yet know the full range of hominins that inhabited both Africa and Asia in the Late Pliocene and Early Pleistocene. Even in east Africa, several new taxa have been claimed in the past two decades and doubtless more will be found. (An indication of how little we know about Pleistocene east Africa is that only recently has the first fossil evidence for chimpanzee been found.). In Asia, the recent discoveries of Homo *georgicus* and H. *floresiensis* should make us very wary of assuming that Homo *erectus* s.l. was the only player on the Asian stage in the Early Pleistocene. Third, Asia might not have been the passive recipient of whatever migrated out of Africa but might have been a major donor to speciation events, as well as dispersals back into Africa. Such two-way traffic is well documented for other mammals in the Pliocene and Early Pleistocene, such as Equus and bovids, with more taxa migrating into than out of Africa. There is no reason why hominin migrations were always from Africa into Asia, and movements in the opposite direction might also have occurred, as has been suggested for the Olduvai and Daka specimens (126,127). We should even allow for the possibility that Homo *ergaster* originated in Asia (128) and perhaps explain its lack of an obvious east African ancestry as the result of immigration rather than a short (and undocumented) process of anagenetic (in situ) evolution. Although Darwin's suggestion (129) that "it is somewhat more probable that our early progenitors lived on the African continent than elsewhere" is widely quoted, it is worth noting his next sentence: "But it is useless to speculate on this subject ... since so remote a period the earth has certainly undergone many great revolutions, and there has been ample time for migration on the largest scale (20).

We obviously need ways of testing these alternatives. The overriding need is for data sets from Asia that are of comparable quality to those from Africa. Although absence can never be 'demonstrated', we can at least put some constraints on its probability by comparing the quality of the fossil record from the inferred core and its 'peripheries'. Because the species we are interested in were not very abundant in their world and hence in the fossil record, knowledge of biasing factors is a prerequisite for the study of their past distributions. The higher the trophic level of a species, the smaller is its

abundance in the real world and hence in the fossil record (for the whole of the Asian Late Pliocene, we have only two records of a puma, for example, separated by more than 3,000 miles). Open, mesic-to-arid environments tend to preserve fossils better than do forested and wetter environments (which is probably why we have no fossil record for the gorilla and only one observation—from open woodland—for the chimpanzee). Should faunal remains get covered in a sedimentary matrix, that matrix obviously has to survive and be accessible, a condition that is rarely met for Pliocene and Pleistocene sediments.The Rift Valley constitutes a unique exception by its sheer size and the exposure of finegrained sediments of the relevant age, and includes many of the key African sites, as well as Erq elAhmar, 'Ubeidiya and Gesher Benot Ya'aqov in Israel (20).

"Regionalimbalancesandfuturechallenges: Current large-scale imbalances between regional records are often the result of differences in research history and intensity. To some degree the Javan and Levantine records result from research initiated during colonial times, and the east African record similarly owes a great deal of its incipient (and prolific) research to the consequences of its colonial history. In contrast, most parts of Asia have experienced only a very limited survey of Neogene exposures, in comparison with the heavy palaeoanthropological investments made in east Africa during the past four decades. These regional imbalances are crucial. After all, in the early twentieth century, east Asia was thought to have been the centre of human origins because it had the oldest fossils, and one of the marginal areas, Africa, had not yet seen any significant field-work. Despite the imbalance in research intensity (and hence number of sites), Asia has produced major surprises in recent years, a testimony to its palaeoanthropological potential. As an example, recent research in China has extended its earliest hominin presence up to 1.66 million years ago, half a million years older than envisaged only a few years ago, with the lowest levels of the fossiliferous sequence in the Nihewan basin not having been reached yet. The increasing evidence for Early Pleistocene hominins in China and Java stretches the limits of current thinking on hominin evolution, as do the finds of Homo *floresiensis* and the Dmanisi hominin assemblage, the latter recovered from an area where few would have expected Early Pleistocene tiny-brained hominins two decades ago. These discoveries underscore our poor ability to discern, let alone predict, the design on the picture we try to piece together from the few pieces of the jigsaw that we have (20).

Again, absence of evidence is not enough: if we postulate that species A migrated into area B, we need comparable data sets to infer legitimately that it was absent before that date - we need not just the FAD (first appearance date) of a taxon in a new area, but also its LPA (last probable absence) (see figure below). We will never have certainty about LPAs, of course: the recently reported finds from Pakefield, southern England, show that two centuries of intensive research of the Cromer Forest beds failed to recover the (indeed ephemeral) traces of an early Middle Pleistocene hominin presence there. That such a surprise can turn up in one of the best-researched areas of the Old World shows that we can never be sure about LPAs and, more importantly, underlines the necessity of working with data sets of comparable quality in both alleged donor and alleged recipient regions . For Africa and Asia, comparability is still many generations of research grants away. Nevertheless, we could do much more to reduce the level of uncertainty over when hominins were last absent in Asia by increasing the number and quality of fossil assemblages immediately before their first alleged appearance (20).

'Africa' and 'Asia', or 'Savannahstan'? We also need different spatial units for investigating extinct hominin populations. Since the time of the Greeks and the Romans, we habitually refer to 'Africa' and 'Asia' as separate continents, each somehow homogeneous and distinct from the other. Plants and

animals (and extinct hominins) are less respectful of our Graeco-Roman heritage. The landmasses we now call Africa and Asia are of course enormously diverse, but they also have many plants, animals and environments in common. In recent decades, rightly emphasized grasslands in hominin evolution, both as a place where many types (including Homo *ergaster*) lived in the Late Pliocene and Early Pleistocene and as having been important in influencing hominin brain size, post-cranial anatomy, and diet. As noted earlier, Pliocene grasslands extended all the way from west Africa to north China, and 'Savannahstan' might prove a more useful spatial unit for modelling early hominin adaptations and dispersals within them than simply an undifferentiated 'Africa' or 'Asia'. For example, the African hominins 1.9–1.7 million years ago at Koobi Fora (Kenya) and Ain Hanech (Algeria), and their slightly later counterparts in Asia at 'Ubeidiya (Israel), and Majuangou (north China) were all living in broadly comparable grassland environments, and it makes sense to place them within the same frame of reference. This might also highlight significant variation that is sometimes buried under a blanket term such as 'Asia'. For example, the hominins in the Nihewan basin, north China, and those in Java are both clearly in east Asia, but those in Java inhabited a region that was considerably more densely wooded. It is not the continent that matters in studying human origins so much as the type(s) of environment with which early hominins were associated (20).

" **Hominins, not just Homo, Outside Africa:** We also need to focus more on hominins and not just Homo when studying early hominins outside Africa. Archaeological approaches to early lithic assemblages in Asia are a good case here. Any stone tool assemblage in Asia dated as older than 1.9 Million years ago (the earliest date that Homo is supposed to have left Africa) is either dismissed or (more usually) ignored (25). The undated Oldowan tools are assumed to date from after 1.9 Million palaeoanthropologists have

the importance of savannah years ago and not from 2.6 million years ago (the date of their first appearance in east Africa); and stone tool assemblages in Asia dated to the Olduvai Event (1.77–1.95 million years ago) and not associated with hominin remains are automatically attributed to Homo *erectus* s.l. However, there is no reason why Oldowan assemblages in Arabia cannot be older than 1.9 million years old, or why the tools from Ain Hanech (Algeria) or Erq el Ahmar (Israel) were made by Homo *erectus* s.l., not least because similar assemblages were made in east Africa at that time (and earlier in some cases) by Homo *habilis*, Homo *ergaster* and probably Homo *rudolfensis*, *A. garhi* and *Paranthropus*. We may be due for some big surprises in discovering that Homo *ergaster* was not the only, or even the first, African toolmaking hominin to leave home (20).

Human Evolution Writ New? Asia has produced some surprising discoveries in the past decade, including two new palaeospecies of Homo. Recent African discoveries in Chad are also highly pertinent hominins. *tchadensis* beyond the east African Rift in the late Miocene, and A. *bahrelghazali* indicates that the African grasslands were probably colonized by 3.0–3.5 million years ago. The latter discovery raises obvious implications for when the Asian grasslands were first colonized, and whether large brains, modern body size and proportions, and obligate bipedalism were essential for that process to occur. These recent finds are not easily reconciled with the notion that hominins originated in the Rift Valley and that Homo *ergaster* was the first and only hominin to migrate out of Africa in the Late Pliocene/Early Pleistocene. Most probably, we are on the threshold of a profound transformation of our understanding of early hominin evolution that might prove as farreaching as the demise of the notion of Man the Hunter in the early 1960s. The process was often painful and accompanied by heated debate, but our understanding of early hominin subsistence improved enormously (and, indeed, some parts of the original model were strengthened by it). Although there

will doubtless be an understandable reluctance to abandon Out-of-Africa 1, in its present form, as a model that is widely accepted as adequate for explaining a very small amount of data from Asia, there are benefits to be gained by widening our range of possible hypotheses (20).

Thepresentmodelisstiflingarigorous evaluation of how we can interpret the sparse, but recently much improved, data upon which it rests. Useful initial steps would be for us to be more explicit about just how few reliable observations we have of Early Pleistocene hominins across the Old World. Other steps would be to pay more attention to the comparability of data sets when evaluating whether or not the absence of hominins is more than the outcome of taphonomic circumstance or the history of fieldwork; additionally, an emphasis on to those interested in early Asian

The discovery of Sahelanthropus shows that hominins were already well different spatial units and on hominins other than Homo *ergaster* (including earlier ones) might prove fruitful. Meanwhile, if we cannot demonstrate the probable absence of a hominin (including Homo *erectus*) in a region, we should reserve judgement as to when it first appeared there. Another useful step would be to dispense with most of the arrows indicating movement from alleged (but often unproven) core territories into (alleged but often unproven) peripheral ones. It might be more profitable instead to focus on populations as the basic unit of study (see figure above), each of which might have its own local origins and history, and to accept that the boundaries of each, and the relations between them, are at present unknown, because all we have are isolated sampling points. Although these changes would radically alter the way in which we view human evolution outside Africa, they might prove more fruitful than continuing to envisage the earliest evidence for hominins in Asia as the outcome of a conjectural migration, from an unproven centre of origin and along hypothetical routes of dispersal (20).

CONCLUSION

Till recently, the prevalent view has been that hominins did not colonize Asia before a million or so years ago; the site of Ubeidiya in Israel, which is probably between 1.1 and 1.0 million years old, has often been cited as the earliest evidence of hominins outside Africa. This dominant model has been challenged in recent years by claims of hominin remains and/or stone tools considerably older than one million years from both Europe and Asia. Of particular relevance to this discussion are the stone artifacts from Riwat and Pabbi Hills in Pakistan, which were dated to a minimum of 1.9 million years ago (19,25,53) and subsequently to a probable age of 2.5 million years ago. This anomalous discovery has recently been joined by other claims that hominids were in Eurasia before 1.5 million years ago, notably in Java by 1.8-1.6 million years (17), at Dmanisi in Georgia at 1,8 million years ago (54), at Longgupo, China, at 1.9 million years ago (55), and at Orce, Spain, at 1.8 million years ago (56). If anyone of these Asian claims is correct, there must be sites in southwest Asia that are older than Ubeidiya. Early Eurasian dates are therefore back on the agenda, raising the possibility that hominins dispersed out of Africa much earlier than was once thought.

It is now generally agreed that the initial "out of Africa" forays were made by small groups of hominins over many millennia ago, and probably made several times over human evolution. One most prominent case would seem to be the case for populations associated with the well-documented Acheulean industry found in so many places in the West up to the middle of India. Still, all this research has not been able to offer a satisfactory answer to the question *when*, much less to *why*. Robin Dennell has examined this issue quite thoroughly (3,56). In this connection, he has pointed to

the weakness of our current knowledge of human evolution from the Pliocene to the Middle Pleistocene; the likely extent of the environment inhabited by early hominids; and, whether the ability to make stone tools would have been characteristic of all extinct hominins, and not just the genus *Homo*. This especially applies to the situation in Asia where material evidence is particularly scanty and where enormous areas are still wholly devoid of evidence.

It has been pointed out that both the number and the density of well-dated sites in Asia with early hominin remains and/or early stone artifacts are extremely low, especially when set against the enormity of the Asian landmass. This is particularly true of the area between the Ubeidiya in Israel; Dmanisi in Georgia; and Riwat in Pakistan. This area is larger than East Africa (Kenya, Tanzania, Ethiopia) and the countries of the European Com munity combined, or larger than the whole of Europe west of the former Soviet Union. Southwest Asia should be a key link between Africa, Europe and eastern Asia; however, apart from Ubeidiya, its earliest occupation is wholly unrecorded. There is, therefore, almost no information against which individual claims, such as Riwat (Pakistan) or Longgupo (China), can be checked. Indeed, west of Riwat, the nearest reasonably well-dated Lower Pleistocene sites are Dmanisi, 1,600 miles to the northwest, and Ubeidiya, 2,200 miles to the west. In contrast, the maximum distances between European localities is only 1,300 miles, and in East Africa, all the localities between Laetoli and Olduvai in Tanzania and the Omo Research Area in Ethiopia lie along a strip only 600 miles long. The enormous distances between key early hominin and archaeological localities in Asia are critically important to the level of confidence that can be attached to assessments of when Asia was first colonized. Not only is there no means of predicting Th.e age of the earliest sites, but there is no secure means of assessing new evidence.

In the face of the limited knowledge of hominin dispersal in Asia as a whole, the speculations on the earliest hominin occupation of South Asia remains quite problematic, if not hopeless. Some evidence is definitely offered but it is quite controversial. One of the best contenders for an early occupation of South Asia comes from the Upper Siwaliks of Pakistan. As reviewed elsewhere in this book, localities in the Soan Valley and Pabbi Hills contain stone artifacts consisting of unstandardized cores and flakes, indicating typological and temporal affinity with the Oldowan in East Afrca. Although the research of the Upper Siwaliks has not been conducted without criticism, the results are key to our understanding of the spread of hominins in this area in the Late Pliocene and Early Pleistocene timescale. Independent support for Dennell's prolonged research is provided by Turner and O'Regan (49) who argue that the most prob

due for some big surprises in discovering that H. ergaster was not the only, or even the first, African tool-making hominin to leave home. In Search of Adam (and Eve) Human evolution writ new?

As readers of this journal will be aware, Asia has produced some surprising discoveries in the past decade, including two new palaeo
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tools are made and used by pre-human apes, such
when the Asian grasslands were first colonized, and whether large as chimpanzees. Thus, it cannot be said with any

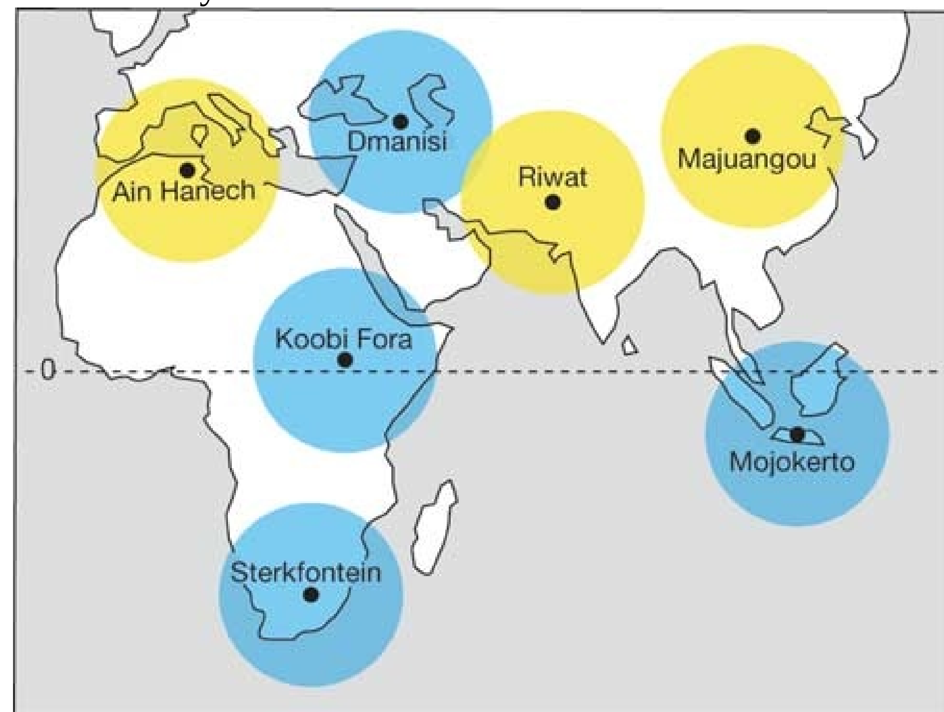


Figure 2 | The hominin world about 1.7 Myr ago. The circles denote radii of **T**
he hominin world about 1.7 million years ago. The circled

1,000 miles. Blue circles indicate known populations of Homo at this time: H. ergaster**denote dadii of 1,000 miles. Blue circles indicate known** in east Africa,**populations of Homo at this time (through fossil recrd): The**

Homo in southern Africa). The ancestries of H. ergaster, H. georgicus and**yellow circles indicate areas with no fossil hominid evi**
H. erectus are unclear, as are their spatial extents and relationships to each
dence but where some stone tools were being made: north
other. The yellow circles indicate areas with no fossil hominin evidence but
China, Algeria and Pakistan (Robin Dennell)

where stone tools were being made: north China, Algeria and Pakistan. As shown, there is ample 'ecological space' in Asia for more hominins than currently recorded.

degree of certainty that the primitive pebble tools !""#!**Nature Publishing Group**!found in Pothwar were made by a homonin.

With a few notable exceptions, it is often implicitly assumed, in attempts to write culture histories or human phylogenies as continuous narratives, that initial dispersion of humans in the Old World was followed by colonization and sustained occupation of some definite regions of habitation. However, in view of recent research, it may be more appropriate to assume that there were numerous hominin dispersal events and that occupation was often discontinuous and intermittent as there are several regions of the Old World which have been colonized at an early age, abandoned for millennia, and

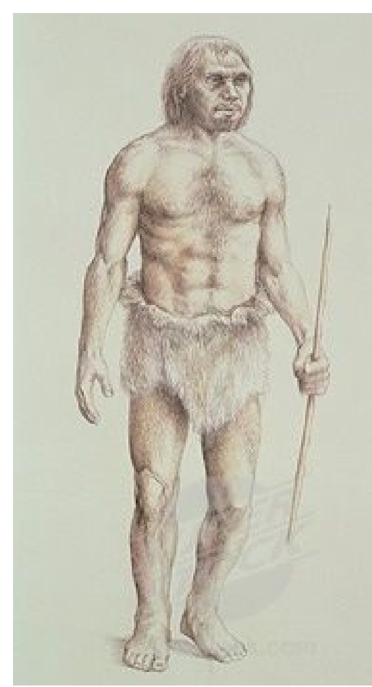
then re-colonized. Northern Pakistan is a case in point. This area, particularly the Soan Valley in the north of Punjab, was presumably first colonized between 1.8 and 2.1 million years ago and the hominin populations thrived there for a long period of time till the onset of the last glaciations, at which time the population drastically decreased, either through out-migration or extinction. The region was re-colonized in the Holocene period, some 10,000 years ago. The same type of evidence has been cited from the Peshawar Valley in the Middle Stone Age where some increase in population, as judged from increased number of artifacts, was shown in conjunction with a corresponding decrease in the Pamir Knot area, indicating there an outright outmigration, or even an extinction.

A similar story unfolds in the Lower Indus Valley where lithic record vividly shows repeated habitation and depopulation events corresponding with the ‘dry’ and ‘wet’ cycles which were of quite long durations. The evidence coming from the Dry Zone is clinching although the reasons for outmigration, extinction, and repopulating may be different. Here two ‘dry’ periods, separated by a ‘wet’ period have been noticed in the Thar Desert. The area at the fringes of the Desert was, as judged from the frequency of the stone tools, heavily populated in the wet phase but got essentially depopulated in the dry phase. As the second wet phase ensued, the population gradually returned.

If hominins were tool-dependent creatures, as is usually assumed by archaeologists and anthropologists alike, then the availability of useable stone for tool-making would be of critical importance.In contemplating the presence of tooldependent hominins in the subcontinent, Dennell (84) has highlighted geographic differences in stone availability between the Siwalik Hills and the Ganga-Jamuna drainage system. Dennell plausibly reasons that the wide floodplains of the Ganga with scarce workable stone, presented serious challenges to hominin adaptation, thereby accounting for the lack of early Stone Age sites. In this view, the conditions in the large river systems of the Gangetic region were not conducive to hominin settlement until deposition of boulder conglomerates in the early Middle Pleistocene. The situation in the IndusHakra plains was also the same but here occasional chert outcrops along the lower Indus provided some excellent working stone to the early hominins.

II.4. *Et tu Homo sapiens!*

The Appearance of Modern Man



Though the various stops in human journey, mentioned in the last two chapters, are interesting to look at and though their study is necessary for tracing the route of this venture, it is the ‘modern man’, the Homo *sapiens sapiens*, who is of primary interest to us. It is he who ultimately inherited the earth and it is he for whom the bells tolled. This chapter is intended to look at the circumstances under which the modern human emerged and review the various theories and models that have been offered to account for his origin and

dispersal throughout the world. Of course, our ultimate aim is to comprehend how ancient Pakistan and the surrounding areas were populated by peoples who looked like us and acted like us.

The study of the origins and spread of modern humans is an interesting topic but it is one of the most contentious areas of anthropological research. It has been so for well over a century. In fact the question of when, where, and especially how people fundamentally similar to ourselves first appeared were subjects of considerable debate for natural historians, philosophers and theologians long before the existence of a human fossil record was documented. Despite the antiquity of the issue, both interest in and debate on it is no less intense today than they were following the recognition of the first human fossil relevant to the controversy in Germany more than a century and a half ago. The strength of current interest is perhaps most clearly reflected by the fact that, since 2000, no less than a dozen major scientific volumes have been devoted to discussion of modern human origins (see the Bibliography). Although they evidence a notable lack of unanimity in terms of interpretation, the syntheses published in these volumes reveal that existing knowledge pertinent to the evolution of modern humans is impressive. In addition to an everexpanding fossil record and a large number of new analytical techniques that facilitate study of this record, various forms of genetic data on living humans populations and a series of new chronometric age estimates for key hominin fossils are profoundly influencing scientific perspectives on how we came to be as we are.

This debate is not only important for theoretical considerations but is also pivotal to the discussion on the dispersal of humans in the entire Old World, to be discussed in the next Section. Obviously, the peopling of Pakistan in the late Pleistocene hinges on the assumptions made in this debate. Since this is an important issue in the prehistory of Pakistan, or for that matter in the prehistory of any other region, we shall devote a considerable space to the understanding of this controversy.

The study of the evolution of modern man has so far been Afro-centric, followed by Europe and the Near East. South Asia has generally been neglected. In Pakistan, for example, the only studies worth pondering over are those of R.W.Dennell and his associates(1,2,3,7,19,20,130,131) while in India there is not a single study so far. This is, however, no impediment to the present discussion as the evolution and dispersal of modern humans can only be studied on a global scale. The purpose of this chapter is to review the major explanatory models derived from the presently available fossil, archaeological and genetic data in other regions and see as to which model more favorably explains the 'arrival' of modern humans in Pakistan or in South Asia generally.

The qualifying term 'anatomically modern' is used to identify our early ancestors that were physically much the same as living humans, but also to distinguish them from earlier hominins that could be called 'human' at some level based on features such as an increased brain size relative to body size and the possession of a material culture (including stone tools). The fossil record of the past 2 million years shows later humans evolving from earlier humans, the last group of them often referred to as 'archaic humans'. What is less clear is the evolutionary relationship of modern humans to the various archaic human populations, as well as to their earlier ancestors, such as Homo *erectus*.

These and other questions fall under what has been termed the 'modern human origins debate'. Although this debate is often focused on the fossil and archeological records, studies of genetic variation have become increasingly important as a source of insight. Much of the work in this area has consisted of detailed analyses of patterns of genetic variation in living human populations. The strategy

What does it mean to be human?

Homo sapiens are one of 180 species of primates (the highest order of mammals). They share some characteristics with certain other mammals, but they also have their unique features. They are bipedal, that is, they walk upright on two, not four legs. As an adaptation to bipedalism, their legs are longer than their arms, and their back-bone has an S-shape. Their hands are prehensile, i.e., are well suited to grasping. The fingers and large thumb (which can rotate through a 45 degree angle) can be used together to grip a stone tool or a pencil. Compared to other animals, their jaw is small and they do not have protruding canine teeth. Females of most animal species are sexually active only during limited periods known as *estrus;* such a cycle is absent in human females. Human infants are born with undeveloped brains (only 25 per cent of the full adult size) and remain helpless and dependent on maternal care for a very long time compared to other mammalian species.

The story of hominin evolution is, among other things, a story of an increase in brain size, and increased brain size can be connected to greater memory storage, learning abilities, and more complex behavior. The average brain size of modern humans is large (1450 cc.), compared to that of chimpanzees (393.8 cc), *Austraiapithecines* (507.9 cc) and Homo *erectus* (973.7 cc). However, the issue is not just one of absolute brain size or weight, but brain size and weight in proportion to the total body size. The brain of an elephant is more than three times as heavy as that of a human; this

doesn't make the elephant smarter than us. Similarly, the brain size of men tends on average to be larger than that of women. This does not mean that men are necessarily more intelligent than women.

Human-ness includes cultural as well as biological characteristics and these have always been interdependent. 'Modern human behavior' includes several traits, not all of which are easy to deduce from archaeological evidence. All animals adapt to and interact with their environment, but human communities have a greater ability to manipulate and transform their environment through the creation of specialized technology. It has been argued on the basis of experiments that chimpanzees and orangutans can make and use simple tools. But humans have a unique ability to make specialized tools, both varied as well as standardized, and travel considerable distances to obtain the desired raw materials.

It is possible that orangutans can learn to use symbols for communication. But there is no doubt that the human thinking capacity is far superior to that of members of the ape family and that human social behavior and cultural systems are far more diverse and complex than those of the apes. Other traits of human behavior include the organization and delimitation of living space (camp floors, structures, etc.), symbolic thought and expression reflected in art, ceremonial or ritualistic activity (e.g., burials), and ideas of individual and group identity.

While *anatomically* modern humans appeared on the earth almost 150,000 years ago, *fully* modern humans those whose *behavior* can be described as human in the senses mentioned above - appeared only about 70,000-100,000 years ago. Others argue that the earliest traces of some of these ‘human traits’ can in fact be found in species other than Homo *sapiens sapiens*, for instance among the Neanderthals as well as among some of the archaic hominins.
here is based on the realization that whatever our species’ evolutionary past, it has left visible signatures on our genome. Expectations of current genetic variation under different evolutionary scenarios are compared with observed genetic variation in our species in order to test various origin models. Genetics is, however, not the master key to open all the locks to the secrets of human origins. Controversies abound and a hefty skepticism is common place.

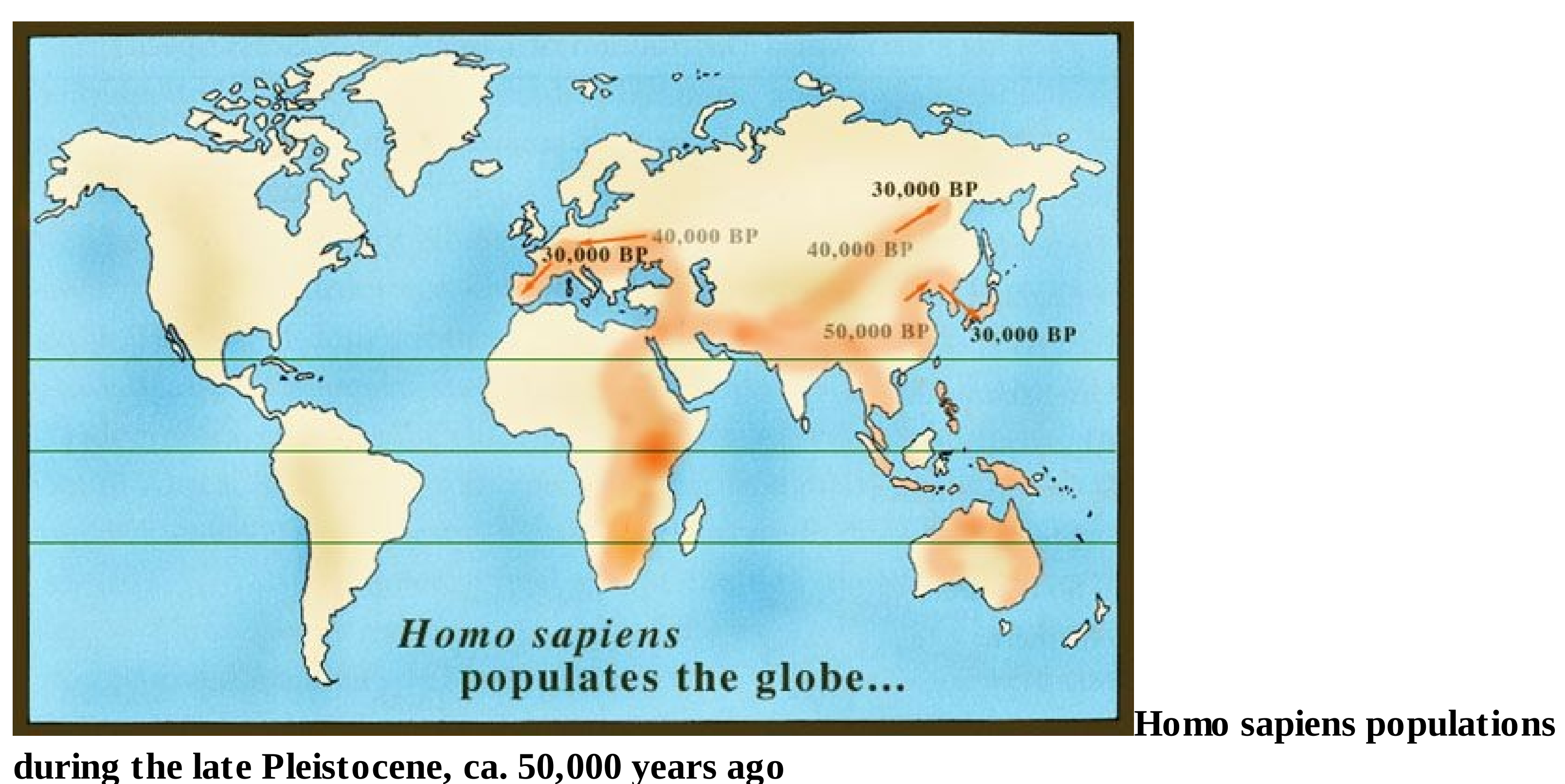
The crux of this debate is the evolutionary origin of 'anatomically modern man' (*Homo sapiens sapiens*) and its recent transformation into ‘behaviorally modern human’. Different models have been proposed to examine the related questions of where and when modern humans first appeared, and to evaluate the genetic and evolutionary relationship between modern humans and earlier hominin populations. The where, why, and when of the transition of the ‘anatomically’ modern humans to ‘behaviorally‘ modern humans are also relevant. In fact, this subject has recently acquired a special focus of attention in the debate of human origin.

It should be evident from the last few chapters that man was millions of years in the making. The path of his evolution is marked by dead ends and new beginnings, the wayside strewn with relics of his various forms. Though archaeological remains are at best minimal, they are nevertheless enough to sketch out the key stages of man’s march through time; the chief problem facing anthropologists today is to fill in the gaps, especially when it comes to the dispersal of humans through Central and South Asia. Here we do not have much to go by except a few fossils and a rich assemblage of stone tools which generations of men left behind for our musing.

The main question that is being asked is: did Homo *sapiens* in most, if not all parts of the Old World, evolve simultaneously, or was there a single geographical place of origin from which modern Homo

sapiens spread to replace existing populations of the archaic species everywhere? In other words, while it is generally agreed that Africa was the evolutionary homeland of Pliocene hominids such as *Australopithecus* and the earliest humans (members of the genus *Homo*), was it also the sole place of origin of our own species, recent Homo *sapiens.* This is not a purely theoretical question: it is important in context of the history of human population in the Old World, especially in the regions like South Asia where we experience an acute dearth of fossil evidence. The perennial question is: Where, when, and how did modem human beings first appear in this region? Furthermore, what happened to those who lived there before them? Where did this population go? Did the archaic humans of Pothwar disappeared from the face of the earth or did they evolve into modern humans? Did they interbred with the newcomers and thus became the integral component of the universal stream of humanity?

These questions are difficult to answer on regional basis because we have practically nothing to base our speculation on; no human fossils, no camping sites, and no artifacts beyond a limited group of stone tools. Nevertheless, we have sufficient evidence from other areas of the world, and through this we can pretty well draw a picture of human journey to his manhood. The ancient populations of Pakistan, obviously, were an integral part of this stream of humanity. The majority of anatomical, archaeological and genetic evidence gives credence to the view that fully modern humans are a relatively recent and unique evolutionary phenomenon although some other evidence cast serious doubts upon such a simple mechanism, showing the human picture to be much more complex.



Homo sapiens populations during the late Pleistocene, ca. 50,000 years ago

Originally centered on the fossil record, the debate has more recently drawn on archaeological and genetic data. The latter have become increasingly significant. Yet, despite the growth of such data, and the availability of increasingly sophisticated methods of analysis, there is still a perception in some quarters that the debate about modern human origins is sterile and as far from resolution as ever. As usual, the evidence is lopsided and incomplete. A principal reason is that most of the paleoanthroplogical work is concentrated in Europe. As a result we know a good deal about one group of men who lived there during those formative years and much less about those who lived

elsewhere. That the rest of the world was occupied, we know very well. Africa was full of people, so was South and East Asia.

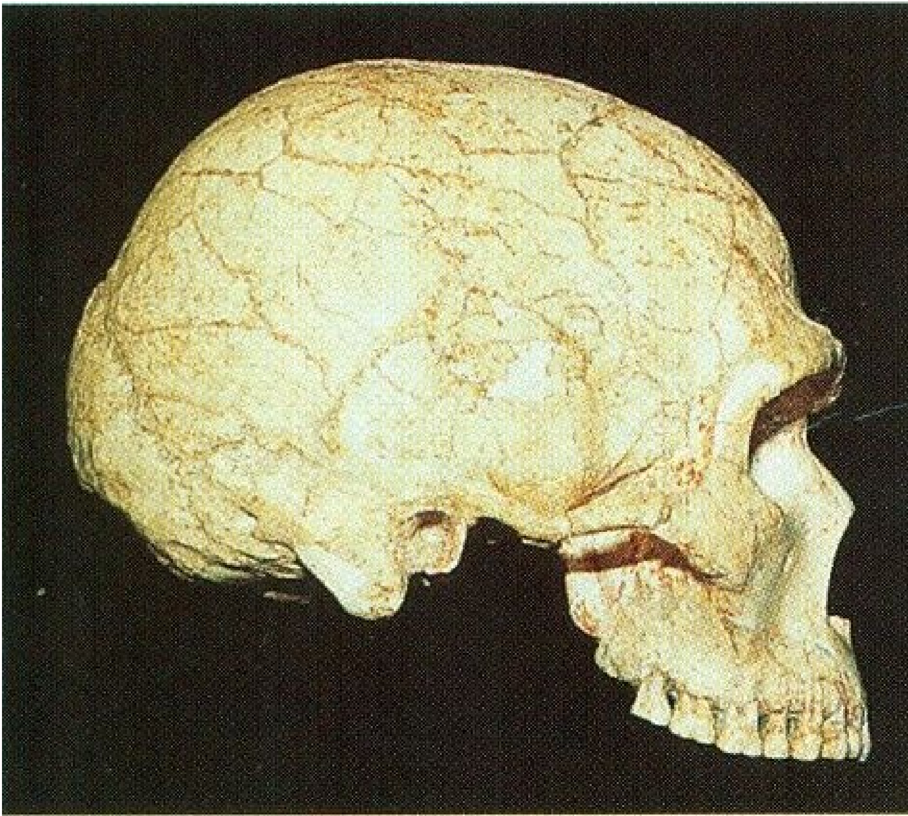
As the reading of the last three chapters reveals, traces of modern humans may go back as far as 200,000 to 250,000 years, but they cannot be said to have emerged in his present form until about 100,000 to 120,000 years ago. This is the point where early humans started to look like us and were virtually indistinguishable from those of today. They did this gradually and unevenly, and the modern men who emerged were not all alike any more than they are alike now. Archaeological record also indicate that although the early Homo *sapiens* acquired the anatomical appearance like ours more than 100,000-120,000 years ago, or even even 200,000 years ago, they did not begin to act like us perhaps until 70,000-100,000 years ago. We are not sure about these dates but they may be taken as handy timeframe for starting the discussion. If we are sure about anything, we know that by 50,000 years ago modern humans were inhabiting a large part of Africa and equally large part of Eurasia, including southern Europe, Western and Southern Asia, East Asia and Australia, as well as a major part of China. The colonization of Europe as a whole and the Americas came somewhat later.

Anatomically and Behaviorally Modern Humans: Anatomically, modern humans can be characterized by the lighter build of their skeletons compared to those of the earlier humans. Modern humans also have very large brains, which vary in size from population to population and between males and females, but the average is around 1300 cc. Housing this enlarged brain has involved the reorganization of the skull into what is thought of as the "modern" appearance - a high vaulted cranium with a flat and near vertical forehead. The widest part of the skull is high on the skull. Other significant morphological changes included: the evolution of a powerful and precision grip; a reduced masticatory system, a reduction of the canine tooth, and the descent of the larynx and hyoid bone , m a k i n g speech possible.

Thehuman species combines a distinct anatomical form with a unique behavioral repertoire, and it is this combination that sets Homo *sapiens* apart from the rest of the animal kingdom. Modern physiology and modern behavior, as indicated by changes in technology, did not appear simultaneously. Archaeological research shows that fossil remains of modern humans apmodern humans ap 150,000 years ago in Africa, but significant changes in technology associated with Homo *sapiens* did not appear until much later about 70,000 years ago in South Africa and 40,000 years ago in Europe, broadly coinciding with the replacement of Middle Stone Age cultures by those grouped in the Later Stone Age (57,58) or the



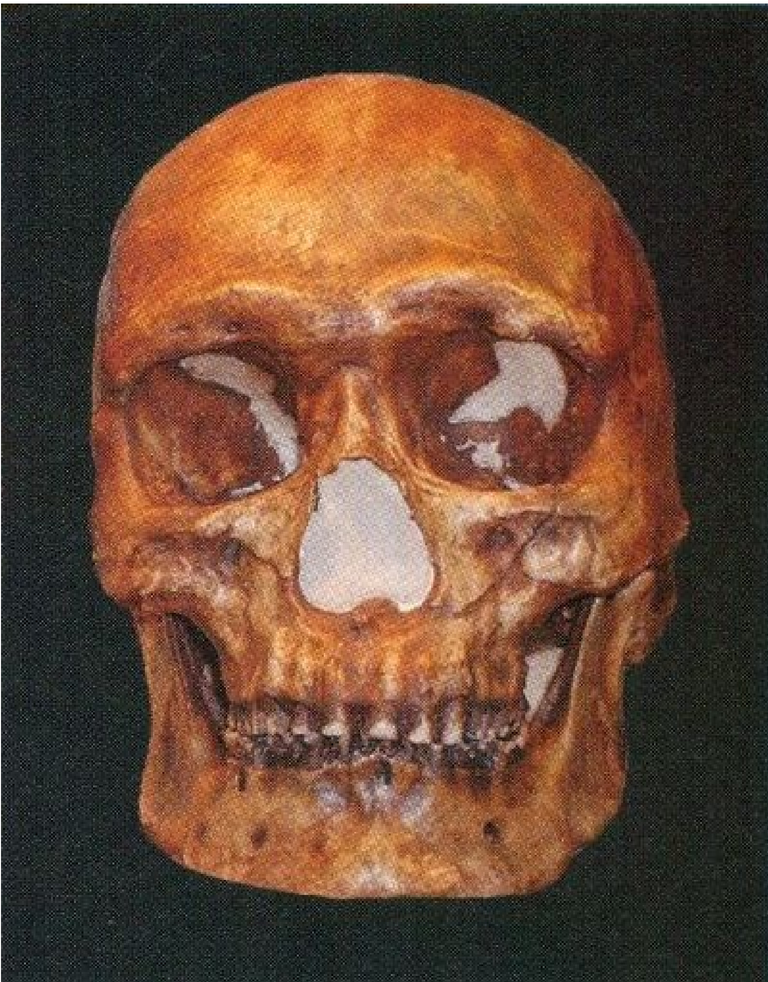
Herto cranium from Ethiopia, dated 160,000 years ago



A modern human skull from Qafzeh, Israel



Reconstructed skull of Omo 1, an early modern human from Ethopia, dated to 195,000 years ago



40,00 years old human fossil from Tianyuan Cave near the archaeologically famous Zhoukoudian village in China

Upper Paleolithic. Opinions differ about the cultural package that separates a behaviorally modern human from a merely anatomically one. Opinions also differ about the timing of appreciable technological changes that made the anatomically modern human a behaviorally modern human. Furthermore, opinions are at variance if this behavioral change was a result of some fundamental genetic changes in the making of man. We know, however, that this change occurred differently in different regions of the world. We shall come to this topic again towards the end of this chapter.

The Fossil Record of Anatomically Modern Man: In order to understand the emergence of the modern human origins debate, it is first necessary to know something about the fossil record for human evolution over the past 2 million years. Such a review has already been provided in the preceding

two chapters. Here we shall confine ourselves only with the fossil record of anatomically modern man.

In Africa, several early fossil finds have been interpreted as anatomically fully modern forms. The earliest of these specimens comes from Omo Kibosh, in southernmost Ethiopia. Recent redating of a fragmentary skull (Omo1) demonstrates that, coming from 195,000 years ago, this is the earliest modern human yet to be found in Africa - or for that matter, anywhere. An interesting aspect of fossil finds at this site concerns the variation shown between the two individuals discovered there. Omo 1 is essentially modern in most respects but another ostensibly contemporary cranium (Omo 2) is much

more robust and less modern in morphology.

Somewhat later African modern human fossils come from the Klaus River Mouth

on the southern coast and Border Cave, just slightly to the north. Using relatively new techniques, paleoanthropologists have dated both thropologists have dated both 80,000 years ago. Relatively recent new fossils from Herto

in Middle Awash area of Ethiopia are also quite interesting. Well-controlled radiometric dating securely places the remains at between 160,000 and 154,000 years ago, making these the best dated human fossils from this time period from anywhere in the world. And note, especially, that this date is clearly older than for any other equally modern Homo *sapiens* from anywhere else in the world. Moreover, the preservation and morphology of the remains leave little doubt about their relationship to modern humans. The cranium is very large, with an extensively long cranial vault. The cranium capacity is 1,450 cc, well within the range of contemporary Homo *sapiens*. Based on these finds in Ethiopia, it seems likely that early modern humans appeared in East Africa by shortly after 150,000 years ago and had migrated to southern Africa prior to 100,000 years ago.

In Israel researchers found early modern Homo *sapiens* fossils, including the remains of at least 10 individuals, in the Skhul Cave. This is very near the Neanderthal site of Tabun, also located at Mount Carmel. Nearby, the Qafzeh Cave has yielded the remains of at least 20 individuals. Although their overall configuration is definitely modern, some specimens show certain premodern features. Skhul has been dated to between 130,000 and 100,000 years ago, while Qafzeh has been dated to around 120,000-92,000 years ago. These humans seem to have either gone extinct or retreated back to Africa 80,000 - 70,000 years ago. The date for Tabun indicates that there is considerable chronological overlap in the occupation of the Near East by Neanderthals and modern humans.

There are six early anatomically modern human location in China, the two most significant of which come from the area near the village of Zhoukoudian. The fossils from these Chinese sites are all fully modern and all are considered to be from the Late Pleistocene, with dates likely less than 40,000 years ago. Just 4 miles down the road from the famous Zhoukoudian Cave is another cave called Tianyuan, from where an important find came in 2003. Consisting of a fragmentary skull, a few teeth, and several post-cranial bones, this fossil is accurately dated by radiocarbon at close to 40,000 years ago. The individual shows mostly modern skeletal features, but has a few archaic characteristics as well. The researchers who have analyzed the remains from Tianyuan suggest that these remains indicate an African origin of modern humans but also show a good possibility of at least some interbreeding in China with resident archaic populations.

A securely dated 100,000-year-old fossil human jawbone has been recently discovered in southern China. It has raised serious questions about when the modern humans migrated out of Africa or even if modern humans evolved exclusively in Africa. The mandible, unearthed in Zhiren Cave in Guanxi Province in southern China in 2007, sports a distinctly modern feature: a prominent chin. The fossil was called "the oldest modern human outside of Africa," by Erik Trunks (59).

The discovery of such an ancient example of a modern human in China drastically alters the time line of human migration and puts in doubt the origins of modern man exclusively in Africa. The find may also mean that modern humans in China were mingling - and possibly even interbreeding - with other human species for 50,000 or 60,000 years. The find also seems to suggest that anatomically modern

humans had arrived in China long before the species began acting human. The jaw and three molars were the only human remains retrieved from the Chinese cave, and the jaw is "within the range" of Neanderthal chins as well as those of modern humans.

The other early modern Asian find is a partial skull from Niah Cave, on the north coast of the Indonesian island of Borneo. This is in actuality not a new find, but was, in fact, fist excavated 50 years ago. These finds have been re-dated, strongly supporting an age of more than 35,000 years ago and most likely as old as 45,000-40,000 years ago, making it perhaps older than Tianyuan. Like its Chinese counterparts, the Niah skul is modern in morphology. It is hypothesized that some population contemporaneous with Niah or somewhat earlier inhabitants of Indonesia was perhaps the first group to colonize Australia.

The occupation of Australia by modern humans appears to have occurred quite early, with some archaeological sites dating to 55,000 years ago. There is some controversy about dating of the earliest Australian human remains, which are all modern Homo *sapiens*. The earliest find so far discovered have come from Lake Mungo, in southeastern Australia. In agreement with archaeological context and radiocarbon dates, the Homo *sapiens* from this site have been dated at approximately 30,000-25,000 years ago. Newly determined estimates, using electron spin resonance (ESR) and uranium series dating, have dramatically extended the suggested time depth to about 60,000 years ago.

The earliest remains of modern humans in South Asia are reported from Sri Lanka, dating to some 32,000-34,000 years ago. These dates are, obviously, much later than the commonly accepted dates for the spread of Homo *sapiens* in this region. In India, Hathnora in Central Narmada valley (Madhya Pradesh) has earlier yielded a partial skullcap, and two clavicles and a 9th rib of Middle Pleistocene hominin. Recent explorations have brought to light two more human fossils - a humerus and a femur from a new locality, Netankheri. The femur is derived from the Middle Pleistocene stratigraphic horizon as the Hathnora skullcap, and shares similar “archaic” mosaic morphology of Homo *heidelbergensis*, also attested by new biostratigraphic and Palaeolithic data. The humerus is derived from the (~75,000 years ago) Upper Pleistocene strata in association with unique fossilized bone artifacts and documents the early emergence of anatomically modern *Homo sapiens* in South Asia. No fossil remains of humans, modern or not, have been found in any part of Pakistan. This, however, does not mean that these were the empty quarters. A large number of stone artifacts, going back to 500,000-700,000 years (a few even to 1.5-2.0 million years), discovered in the north of Punjab (Pothwar region) testify to this fact.

Central Europe has been a source of many fossil finds, including the earliest anatomically modern Homo *sapiens* yet discovered anywhere in Europe. Dated to 35,000 years ago, the best dated of these early Homo *sapiens* fossils come from recent discoveries at the Oase Cave in Romania. Here, cranial remains of three individuals were recovered, including a complete mandible and a partial skull. While quite robust, these individuals are quite similar to later modern specimens, as seen in the clear presence of both a chin and a canine fossa. Another early modern human site in central Europe is Mladec, in the Czech Republic. Several individuals have been excavated here and are dated to approximately 31,000 years ago. While there's some variation among the crania, including some with big browridges, archaeologists are confident that they are all best classified as modern Homo *sapiens*. It's clear that by 28,000 years ago, modern humans are widely dispersed in central Europe and into western Europe.

Western Europe has yielded many anatomically modern human fossils, but by far the bestknown sample of western European Homo *sapiens* is from the Cro-Magnon site. From a rock shelter in southern France, remains of eight individuals were discovered here in 1868. The Cro-Magnon materials are associated with a late Aurignacian tool assemblage, an Upper Paleolithic industry. Dated at about 28,000 years ago, these individuals represent the earliest of France's currently known well-dated anatomically modern humans. The so-called Old Man (Cro-Magnon 1) became the original model for what was once termed the Cro-Magnon, or Upper Paleolithic, "race" of Europe. Actually, of course, there's no such valid biological category, and Cro-Magnon 1 is not typical of Upper Paleolithic western Europeans - and not even all that similar to the other two male skulls found at the site.

Fossildiscoveriesandtheirinterpretation have been the main area of interest so far in the research on human evolution and the origins of modern man. Where such fossils are not available, such as in South Asia in general and Pakistan in particular, the stone artifacts have been studied extensively. In recent years, genetics is furnishing valuable data on the origins and dispersal of modern humans and some of this research is breaking new grounds. Although there are still many gaps, an outline is steadily emerging which is of great interest in solving the riddle of man's origins, his dispersal, and its colonization of the five continents. The majority of anatomical, archaeological and genetic evidence gives credence to the view that fully modern humans are a relatively recent evolutionary phenomenon although some recent evidence cast serious doubts upon such a simple mechanism.

Behavioral Modernity - Homo *sapien sapiens:* Though fossil remains of modern humans appear about 150,000-200,000 years ago in Africa, modern human behavior, as indicated by significant changes in technology and the appearance of symbolism, did not appear until much later. Early Homo *sapiens* apparently continued to use the same technology as that employed by archaic Homo *sapiens*. Beginning about 70,000 years ago, however, evidence of more sophisticated technology and artevidence of more sophisticated technology and art 50,000 years ago fully modern behavior becomes prominent in Europe and the Near East. What caused this transition to occur and what was indeed the nature of this change? Did some behaviorally modern humans immigrate from Africa to populate this region or the modern behavior did arise indigenously? If they migrated from Africa, what happened to the archaic Homo *sapiens* who were already there?
These are the questions that shave been vexing the minds of scholars for the past century and the discussion on this subject has taken up an inordinate amount of energy on the part of archaeologists, anthropologists, and prehistorians alike generating a fairly large pile of literature. We shall try here to summarize this debate but before we begin, a precautionary note need to be struck: the debate has so far been extremely Eurocentric as it exclusively revolves around the Neanderthal and its relation to the appearance of modern man in Europe, largely downplaying the evidence from Asia. Furthermore, all the talk is from the point of view of Recent African Origin.

There are several reasons for such a strong Eurocentric streak in the discussions of the emergence of behavioral modernity. For one, over the last 100 years, many of the scholars interested in this kind of research happened to live in western Europe, and the southern region of France proved to be a fossil treasure trove. Also, early on, discovering and learning about human ancestors caught the curiosity and pride of the local population. As a result of this scholarly and non-scholarly interest, beginning back in the nineteenth century, a great deal of data accumulated from Europe, and little reliable comparative information was available from elsewhere in the world. It's only in recent years, with growing evidence from other areas of the world and with the application of new dating techniques,

that human evolutionary dynamics are being seriously considered from a worldwide perspective.

Behavioral modernity is a term used in anthropology, archaeology, and sociology, to refer to a set of traits that distinguish present day humans and their recent ancestors from both archaic humans as well as anatomically modern humans, i.e. the early Homo *sapiens*. The latter may have looked like us but certainly did not act like us. It is the point at which Homo *sapiens* began to demonstrate a reliance on symbolic thought and to express cultural creativity. These developments are also often thought to be associated with the origin of language.

Common elements used to define modern behavior include the ability to plan ahead; technological innovation; establishing social and trade networks; adapting to changing conditions and environments; and exhibiting symbolic behavior, like cave painting, bead making (used to show status or group identity), or burying the dead. The crux of the argument comes down to whether these abilities resulted from a sudden biological and genetic revolution, or a more gradual evolution of abilities that culminated around 50,000 years ago. Furthermore, it is being debated that if the 'modern man' in fact came out of Africa, as the anatomical man and early homonins did, or they migrated to Europe from Asia, Blombos cave such as 'Persian Gulf Refugia'.



Shell beads from the 77,000 year old layers at Blombos Cave, South Africa.

The transition from anatomically human to behaviorally modern human appears to coincide with late Pleistocene, especially a time period which is commonly designated in Europe as the Upper Paleolithic and in Africa as the Late Stone Age. According to the textbook version of the story, the components of modern behavior appear most prominently around 40,000 years ago in Europe and probably 70,000 years ago In South Africa. At sites throughout Europe, the staid culture of the Neanderthals begins to yield to a set of new and more inventive tool-making techniques. There is now

a new set of stone tools, more carefully crafted to attain specific shapes (e.g., blades, microliths, composite tools). Tools made of bone and antler are seen first time in archaeological record. Also, for the first time the evidence of fishing indisputably indicated in Africa. People start burying their dead which indicates their perception of life after death, overtly symbolic behavior (e.g., art, ornaments, artifact styles, etc.), chronological and geographical variability in artifact styles, artifact standardization, long-distance exchange networks, defined use of space within a settlement and landscape context, and ideas of group and self-identity become apparent. The carriers of this new culture made personal ornaments and were avid hunters who could take down large animals. They could support denser populations. Scientists attribute these changes to the development of language.

The emergence of modern human behavior around 40,000 years ago or somewhat earlier than that is almost universally regarded as a sudden change in technology, in fact a 'revolution' and this has become the stuff of college textbooks all over the world. Because behavioral modernity seems to occur as a sudden event, some scholars advocated that it was possibly a result of a major genetic mutation or as a result of a biological reorganization of the brain. Such a biological change did not occur the first time; several other and similar genetic jumps are seen in human evolutionary history. For example, it was a genetic change, not a cultural one, that endowed the austropithecines with upright stature 4.4 million years ago. It was a suite of genetic change 2.5 million years ago that remodeled the autralopithecines into Homo *Habilis* with its larger brain and tool-making ability. A third farreaching genetic makeover some 2 million years ago reshaped *habilis* into the more humanlike *erectus*. And it must have required a fourth genetic revolution, Klein believes (57,43), to make possible the emergence of behaviorally modern humans some 70,000 years ago in Africa which later showed up in Europe ca. 40,000 years ago. It was referred to as the *Great Leap Forward* or the *Upper Paleolithic Revolution.*

The archaeological data of Europe is generally interpreted through this theoretical concept. This concept of a sudden change was most vocally advocated by Richard Klein and most scientists engaged in the study of man's origins tend to subscribe to this notion. Klein's argument of sudden behavioral change is, however, not universally accepted by archaeologists, some of whom have attacked a principal element in his case: the sharp discontinuity he sees between the behaviors present at the end of the Middle Stone Age and the beginning of the Later Stone Age. These critics argue that there was a gradual accumulation of advanced behavior throughout the Middle Stone Age that eventually added to modern behavior, not a sudden change that some archaeologists note. Proponents of this view argue that modern human behavior is basically the result of the gradual accumulation of knowledge, skills and culture occurring over hundreds of thousands of years of human evolution. "As a whole the African archaeological record shows that the transition to fully modern behavior was not the result of a biological or cultural revolution, but the fitful expansion of a shared body of knowledge, and the application of novel solutions on an 'as needed' basis" write McBearty and Brooks (27), the two most vocal critiques of Richard Klein.

Klein and coworkers also believed that there was no modern behavior in Africa prior to 50,000 years ago, although modern humans existed there a long time ago, meaning thereby that anatomical modern humans took considerable time to evolve the older behavior, again reinforcing the theory of a genetic change. This view that there was no modern behavior in Africa prior to 50,000 years ago, once uncontradicted by any evidence, has now been challenged by several recent finds. For instance, Christopher Henshilwood recently found a set of 41 shells, all perforated in the same way as if meant to serve as beads on a necklace. The shells were excavated from the Blombos cave in South Africa;

the sand in which they were found has been dated to 76,000 years ago by physical techniques.This discovery, and a few others like it in South Africa, seem to be earth-shaking in anthropology but on theoretical grounds they are in no way fundamental. Whether modern behavior began 50,000 years ago or 70,000 years ago is not a game changer. The important and fundament point is whether the emergence of modern behavior was as sudden as it is portrayed and if it was caused by some genetic change in human brain.

'Modern man' appeared on the European scene with a bang and the appearance of behavioral modernity, with all of its trappings, was felt like a revolution. It was, in short, a 'a great leap forward' for humanity. The truth is, however, that all the evidence pertains only to Europe and cannot be generalized. In West Asia, South Asia, and the Orients, we do not observe such a 'technological revolution' or hear the loud trumpet announcing the arrival of 'modern man'. Here, the cultural changes were gradual, in fact a continuum. The archaeological record of South Asia shows no rapid or sudden appearance of the modem behavioral package that can be considered equivalent to the Aurignacian in Europe, nor does it indicate the spread of an Upper Paleolithic package at around 50,000 years ago (99). In short, the trajectory of 'modem human behavior' in South and East Asia is distinct in comparison to Europe. All this goes to indicate that the sudden emergence of 'modernity' was either a regional phenomenon in Europe or a misinterpretation of the evidence.

Looking at the archaeological evidence (or a lack of it) in South Asia, it is difficult to differentiate the 'behaviorally modern man' from that of the 'anatomically modern man', even the 'archaic' populations. The archaeological record shows a gradual shift in technology. The gradual and mosaic-like pattern of change in cultural traits in time and space indicates that material culture and symbolic objects developed in fundamentally different ways as modern humans spread around the globe. In Europe it was probably as sudden and profound as is generally believed, in other parts of the world it was gradual and imperceptible.

The development of new cultural innovations in the Late Paleolithic of South Asia may be related, in part, to fluctuations in the environment and demographic changes.The wetter and more stable conditions during Oxygen Isotope Stage 3 (60-25,000 years ago) may correspond to a demographic expansion proposed on the basis of mitochondrial DNA analysis between 30-20,000 years ago. Occupation in the Thar Desert becomes increasingly sparse after ca. 25,000 years ago, reflecting the heightened aridity and loss of available water sources. Increasing aridity and expansion of the Thar Desert would have reduced and fragmented existing populations. Such demographic and environmental conditions may be tied to some cultural innovations occurring between 30-20,000 years ago, including the introduction of microlithic assemblages and the manufacture of symbolic artifacts (i.e., beads and 'art').

Doubts are also being expressed on the packaging of evidence for "modernity." Does the evidence show a tightly packaged behavioral change, that is, did all modern traits appeared more or less simultaneously around 40,000 years ago in Europe or 70,000 years ago in south Africa? Or, are the various indications of modern behavior scattered over a time span from 200,000 to 50,000 years ago, some in Africa and some in Europe? These questions are the subject of ongoing debate. A few years ago John R.F. Bower published an article (211) wherein he considered some of the literature revealing diametrically opposed views concerning the emergence of "modern" behavior as it relates to the study of modern human origins. Anyone who has kept an eye on human origin research over the past several years would agree that there has been little, if any, progress toward resolving the

contradictions described in this section although Bower himself later tried to come up with a synthesis that could be acceptable to most, if not all anthropologists and archaeologists (212). The situation is still the the same and the answers to this issue are more speculative than substantive, more tentative than conclusive. In fact, the positions are further hardening on reach side. Besides a number of largely reasoned treatments of the subject that have appeared lately, quite a few articles have have appeared that pooh-pooh the whole idea of the 'modern man', especially the emergence of 'behaviorally' modern man. For example, Robert Badnarik (147) calls them 'mythical moderns'.

ApproachestoUnderstandingModern Human Origins: Scientific interest in all the phases of human evolution in the Pleistocene has been driven and channeled by a natural human preoccupation with the question of how we came into existence. A number of scenarios and theoretical models have been proposed to answer this question. Conflicts between competing models of modern human origins therefore underlie a lot of seemingly unconnected arguments about human evolution - not only about the first truly modern-looking human remains in the Late Pleistocene, but also about the meaning of earlier hominin fossils and the way the processes of evolution have worked throughout the history of the genus *Homo.* To understand these arguments, we need to understand the various models that have been offered to explain the origins of man and his dispersal over the globe. This is a controversy-ridden topic, indeed.

Historical Background: During the first half of the 20th century, paleoanthropologists debated several conflicting models of modern human origins, the bits and pieces of which we can detect in the currently popular visualizations. Vallois (60) grouped early humans under three general headings: Pre-sapiens, Pre-Neandertal, and Neanderthal phases. These widely used labels obscured the significant variation found within each group. All the Neanderthal Phase models, for example, depicted the European Neandertals as ancestors of modern humans. However, some proponents of this idea, especially Weidenreich (61,62) saw the Neanderthals as specifically ancestral only to today's European and West Asian populations, whereas Hrdlicka (63) believed that Neanderthals gave rise to early modern humans in Europe and that these early moderns then spread from Europe into the rest of the world. Both stories are "Neandertal-specific" models in Vallois's sense. But Weidenreich's version is a precursor of today's *multiregional evolution* model, which posits regional genetic continuity between archaic and modern humans in various parts of the Old World (64). Hrdlicka's version resembles today's single-origin models, which view modern humans as originating in one small area and then spreading outward to replace more archaic populations.

The Pre-Neandertal models held that modern humans evolved from some archaic human ancestor(s) somewhere in the Old World. This ancestry might have included the early, "progressive" Neanderthals (early European and Near Eastern specimens), but it excluded the later and more specialized "classic" Neanderthals of Europe. Such models were propounded by the American scientists W.W. Howells (65) and F.C. Howell (66). They promoted more or less monocentric theories about modern human origins, although both were often vague on the location of the "center." In a series of papers and books spanning more than three decades, Howells argued for the expulsion of Neanderthals from modern human ancestry and intimated that modern humans had originated somewhere to the East of Europe. Broadly speaking, these ideas can be seen as precursors of today's leading singleorigin theory, the *Recent African Origin mode*l, although the focus on Africa as the center of modern human origins came later.

The patterns of genetic polymorphism seen in living human populations suggested to Howells that the

center for modern human origins might have been in Africa. Leakey and Protsch had put forward similar ideas earlier, but their arguments were founded on questionable dates attributed to certain African fossils. Rightmire focused attention on later human fossil remains from Africa and suggested cautiously that the first modern humans might have appeared there. But it was the German paleoanthropologist Gunter Brauer who first unequivocally argued that Africa was the place of origin of modern humans, a conclusion based on his own extensive analysis of the pertinent African fossil record. Like Howells, Brauer accepted the theoretical possibility that "hybridization" could have occurred between modern humans and more archaic forms. But his later writings indicate that he does not regard interbreeding as a significant factor in the peopling of Eurasia by early modern humans.

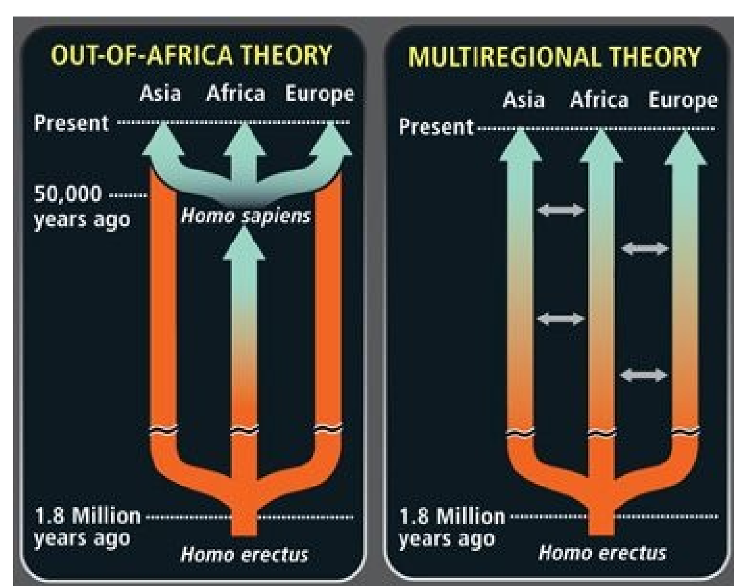
And then, there were the so-called Pre*sapiens* models, the proponents of which have had a powerful historical influence on the interpretation of many of the fossils considered in this chapter. These ideas are resurfacing again but this time the argument is on genetic grounds. Pre*sapiens* theorists believed that modern Homo *sapiens* had a long lineage separate from those of Neanderthals, and other archaic humans. They argued that this lineage was documented by certain ancient fossils that showed distinctively modern anatomical features, particularly those involving the skull and brain. These thoughts eventually crystallized into different versions of the Multiregional model of human evolution, to be described in the following pages.

Recent Thoughts: In recent years, discussions of the origin of modern Homo *sapiens* have been dominated by two models: the Recent African Origin model (RAO) and the Multiregional Evolution model (MRE). The ongoing debate over these contending models has been summarized in many books and articles (67-72). Both models have connections of one sort or another to the earlier models classified by Vallois, though these connections are not always simple or obvious. Unlike almost all earlier models, both RAO and MRE are based on information drawn from genetic studies as much as on the fossil record itself, and both emphasize strong connections to biological theory. Over their 40-year history, these models themselves have evolved, so that both models as they are currently articulated differ from the versions first proposed in the mid-1980s.

The core question in the modern human origins debate is: What is the evolutionary relationship between archaic and modern humans? Are they a product of a more-or-less linear progression of evolutionary ladder in Africa, such as described in many college textbooks and discussed in the foregoing two chapters, or are they a product of a global development in which Asia and Europe played an important role as did Africa. In other words, at the heart of the debate is whether modern Homo *sapiens* originated from a small group of modern men appearing among an African population between 150,000 to 200,000 years ago and then spread out across the globe, rapidly displacing indigenous archaic populations everywhere (as RAO stipulates); or whether modern human originated from the interbreeding of indigenous hominin populations with those of the neighboring areas (as MRE proposes). In essence, this is a debate about *evolution* and *diffusion* and, as in other debates of biological and cultural origins in human prehistory, the polarization of opinion into camps seeking to explain change through *in situ* evolution or through diffusion, intuition often takes a back seat.

Starting with Lewis (80), who first included a drawing of the two main models in one of the textbooks on human evolution, several versions of such depictions have appeared, one of them, drawn from a recent textbook, is reproduced below. Both hypotheses in the this figure have the human lineage

initially only in Africa, and both have the human lineage expanding out of Africa at the time of what is now called Homo *erectus,* an expansion most



Pictorial conceptualization of out-of-Africa theory versus the Multiregional theory for the origins of modern man

recently dated to 1.9–1.7 million years ago. As shown on the right, the candelabra model of Multiregional model depicts that three separate lineages of Homo *erectus* were established after this early Pleistocene expansion out of Africa, and each lineage independently evolved into their modern forms in different parts of the world. In contrast, the Recent African Origin and Replacement model shown on the left has an expansion out of Africa at about 50,000 years ago, representing the single African human population that had evolved into modern form. These modern humans then dispersed all over the seven continents, completely replacing the pre-existing archaic populations. The earlier Eurasian lineages are shown as broken, to portray replacement. Thus, all living humans on the planet Earth are descendants of the people that migrated out of Africa.

Both models represent the relationship of African, European, and Asian populations as separate branches on an evolutionary tree, but the branch lengths are very different in the two models. One significant difference that must be noted between the two models is that while the Multiregional model visualizes the emergence of modern man through an unbroken process of evolution right from an early form, supposedly Homo *erectus*, the Recent African Origin model considers the 'modern man", i.e. Homo *sapiens,* as a distinct species that could not, and did not, interbreed with the pre-existing archaic linkages. This is a very fundamental difference between the two.

The Recent African Origin or African Replacement model has been much more popular during the past half a century and is still so, if the school and college textbooks are any guidance. In its essentials, anatomically modern humans arose as a new species (Homo *sapiens*) in Africa between 150,000 and 200,000 years ago. By 100,000 years ago or so, populations of this new species began expanding throughout the Old World, replacing preexisting archaic human species outside of Africa (such as the Neanderthals of Europe and Central Asia). Under this model, there was virtually no genetic input from these archaic populations. All living humans thus can trace all of their ancestry 200,000 years ago to Africa. Of course, there are some variations of this model, differing in details.

The Multiregional evolution model presents a different explanation for the origin of modern humans. This model was first developed to explain how some traits, such as increased cranial capacity and

reduction of the face, could evolve across the Old World while at the same time other traits could retain regional distinctiveness over time, such as the high prevalence of shovel-shaped incisors in past and present Asian populations. The seeming conflict between similarity between populations and regional continuity over time was explained by a balance of gene flow, selection and genetic drift (73,74). Like the Replacement model, different versions of the Multiregional model have their own shades and sometimes indistinguishable from that of the Recent African Origin model.

According to some proponents of the Multiregional model, there was no single time or place associated with the origin of modern humans. Indeed, some have argued that the distinction between archaics and moderns is arbitrary and difficult to define. Instead, this view of Multiregional evolution posits that the anatomic and genetic changes leading to modern humans took place piecemeal across the Old World, and modern humans eventually resulted from the regional coalescence of these changes. Contrary to some representations of the earlier Multiregional model, the current versions do not claim that the appearance of modern humans was due to independent or parallel evolution in different parts of the Old World. (73,74): the evolution was global in scope and process; all changes took place within a single evolutionary lineage.

The two proposed models just described are often presented as two diametrically opposing views. This is to some extent true in their bare bone formulations, but in reality this dichotomy is a bit of an oversimplification, because there is overlap between some variants of these models, and the two models are often misrepresented. Adding to possible confusion is the fact that there are two separate but related questions regarding modern human origins (74). The first of these questions concerns the time and place of the transition from archaic to modern humans. Did modern human anatomy emerge first in Africa followed by dispersal across the rest of the Old World, or did modern humans instead emerge because of the mixing of different evolutionary changes taking place in different parts of the Old World? The second question concerns the evolutionary relationship between archaic and modern forms. Were they separate species that arose through cladogenesis with little if any hybridization, or were they part of a single evolutionary lineage (anagenesis)? A lot of confusion apparently stems from combining these two questions into one.

Although the modern human origins debate is frequently discussed in terms of the more extreme views regarding Out-of-Africa and Multiregional models outlined above, in reality a number of anthropologists have argued for models that combine an initial African origin of modern humans with varying degrees of gene flow taking place between modern humans dispersing out of Africa and those preexisting human populations outside of Africa. Relethford has labeled such models ‘Primary African Origin’ models, characterized by the hypothesis that modern human anatomy did emerge first in Africa (in common with the Replacement model), but that there was some degree of genetic mixture with preexisting archaic populations outside of Africa (in common with the Multiregional model). One example of a Primary African Origin model is Smith’s ‘Assimilation Model’ (76); another is that of Bauer’s ‘hybridization’ model mentioned above; and still another is the Wave theory of Eswaran (77,78), to be discussed later.

Despite their composite nature, almost every one of these hypotheses generally lean more to one or the other way. Some of these views draw their strength from archaeological evidence, some from genetics, some from fossils finds, and some invoke the laws of physics and the principles of mathematics. Consequently, it is an involved subject. We shall try to review the two principal models as briefly as possible in the following pages and point to the consequences of accepting one over the

other. We shall also look into some composite models.

Recent African Origin Model: The Out-ofAfrica or Recent African Origin model, also referred to as Replacement Model, is most closely associated with the English paleoanthropologist Christopher Stringer, who outlined its basic tenets in a classic 1988 paper written with his colleague Peter Andrews (82). The ideas of Stringer and Andrews were based both on the fossil record and on new information about mitochondrial DNA (mtDNA) variation in living human populations. As outlined above, the Recent Out of Africa Model asserts that modern humans evolved relatively recently in Africa, migrated into Eurasia and replaced all populations which had descended from *Homo erectus*. Critical to this model are the following tenets:

• After *Homo erectus* migrated out of Africa the different populations became reproductively isolated, evolving independently, and in some cases like the Neanderthals, into separate species.
• *Homo sapiens* arose in one place, probably Africa.
• *Homo sapiens* ultimately migrated out of Africa and replaced all other human populations, without interbreeding.
• Modern human variation is a relatively recent phenomenon.

In essence, RAO incorporates three central claims: 1. It represents the origin of modern *Homo sapiens* as monocentric, in this case Africa,
2. It is a total-replacement model, depicting modern Homo *sapiens* as taking over the ranges of earlier humans and replacing them without interbreeding (Although Stringer later conceded that some slight degree of interbreeding was a theoretical possibility but the genetic admixture between modern and archaic humans had been insignificant (83,84,85,86). 3. It is a speciation model; that is, it proposes that modern human morphology originated through a speciation event. In simple words, Homo *sapiens* was a distinct species, separate from all other homonin species, including the so-called *archaic Homo sapiens*. Two assertions made by Stringer and Andrews are particularly significant in the context of this implication. First, there is little or no evidence for local continuity across the archaic/modern human boundary outside Africa. Second, any archaic-reminiscent traits in Eurasian populations are either primitive retentions found in the incoming African-derived populations.

The Out-of-Africa model received a hefty boost from various genetic studies which had started to appear in profusion by the early 1980's. Although early studies of nuclear DNA polymorphisms were interpreted as pointing to an African origin for modern humans, the strongest genetic evidence for this claim was provided by mtDNA. With the publication of a paper entitled "Mitochondrial DNA and human evolution" by Cann et al. in 1987 (81), genetics started playing an increasingly important role in our understanding of human evolution, especially of the origins of modern humans. Despite the controversies on their methodology, subsequent data and analyses confirmed two points: (1) the mitochondrial DNA tree of modernday human population was rooted in Africa, and (2) all the branches were relatively short, implying a recent common mitochondrial ancestor (dubbed "Eve" in popular accounts). In a sense, Cann's genetic observations confirmed the earlier conclusions reached by Stringer and Andrews (82).

An essential element in Cann's study was the much higher genetic diversity in East African populations as compared with that found in populations outside Africa: one gets less and less variation in genetic diversity the further one moves from Africa. Furthermore, the 'genetic distance' between the studied population groups and that of East Africa increases as one moves away from the center. The idea is that as each small group of people broke away to found a new region, it took only a sample of the parent population's genetic diversity.

For Stringer and Andrews the indication of low nuclear and mitochondrial genetic variability in humans was critical, if not the key, factor in the formulation of the Recent African Origin model. Although Stringer had clearly favored a classic monocentric origin for modern humans and the replacement of Eurasian Neanderthals, his focus on Africa as the modern human homeland and the emphasis on speciation seemingly coalesced as a result of the mitochondria DNA analyses of Cann et al (132).

Apart from the relative differences in the degree of diversity between the African population in comparison with those out of Africa, another major findings need to grab our attention. The entire amount of variation in mtDNA across human populations is small in comparison with that of other animal species. This means that all human mtDNA originated from a single ancestral lineage. This is one of the most important argument that is often cited in favor of the Recent African Origin.

Later on a number similar studies have been undertaken. For example, in a comprehensive study of Y chromosome DNA of a large sample of nuclear genes spread throughout the entire human genome, researchers in 1980s compared 650,000 genetic markers in nearly a thousand individuals from 51 populations around the globe - an unprecedented level of detail for a human genetic study (93). They essentially confirmed the basic expectation of Cann. A number of additional studies, such as that of Lawton-Handley (94), have been undertaken in recent years: they clearly yielded genealogical trees rooted in Africa as well as a genetic gradient away from Africa.

It has been mentioned earlier that genetic studies can be used to calculate an approximate time of divergence from the common ancestor of all modern human populations. Assuming a specific, constant rate of mutation, Cann (81,92) concluded that the common ancestor of modern people was a woman (or a group of women with the same mtDNA) living between 140,000 and 290,000 years ago in Africa, that the ancestral stock of modern Eurasians diverged from the African stock between 90,000 and 180,000 years ago, the dates whichare more or less in the same range as deduced from the fossil evidence. This further strengthens the claims of the Out-of-Africa model for the origins of modern humans, a single species, a single exodus, and complete replacement of pre-existing populations.

Cann et al also posited that interbreeding between these modern people and indigenous archaic hominids was, at most, minimal. In fact, in a more recent assessment of the implications of their mtDNA data on Late Pleistocene human population history, Stoneking and Can state that ".... The rather staggering implication is that the dispersing African population(of modern humans) replaced the nonAfrican resident populations (Eurasian archaic Homo *sapiens*) without any interbreeding" (81).

The main argument for the Out-of-Africa model is genetic; the fossils evidence is not particularly strong but still there remains the fact that so far the earliest finds of modern Homo *sapiens* skeletons come from Africa. They date to at least nearly 200,000 years ago on that continent. They appear in Southwest Asia only by 100,000 years ago (although the recent evidence from southern China pushes it to a remote past, more than 100,000 years ago) and elsewhere in the Old World by 60,000-40,000 years ago. If the dates from Africa are accurate, they are startling, because they show that the modern human beings in Africa predate those in Europe and Asia by as many as tens of thousands of years.

The evidence coming from molecular biology, especially studies of the diversity and mutation rate of nuclear and mitochondrial DNA in living human cells, is strong and an impressive array of data from

the study of human mitochondrial DNA (mtDNA) has been offered during the past several decades to prove the point. Of particular interest are gene trees that reconstruct the time and place of the most recent common ancestor of humanity in different parts of the world and to analyze the regional differences in genetic diversity. Together with the fossil record, genetic data provide insight into the origin of modern humans and their dispersal.

Recent researchers have offered significant refinements and changes to the original Out-ofAfrica model. For example, Lahr (88,89) postulated a serial replacement of Eurasian archaics, involving multiple waves of progressively more and more modern populations coming out of Africa one after another. Others suggest that a weaker "Out of Africa" model, involving variable amounts of gene exchange with indigenous archaic populations, might be an appropriate fit to the data (75,90). In his later presentations, Stringer (133) himself conceded that some hybridization could have indeed occurred between the archaics and anatomically modern humans without being their conspecific. But he also stated that evidence of hybridization between the archaics, such as the Neanderthals, and modern humans has not been established.

The Out-of-Africa model, although broadly accepted, has its critics, some of them vociferous. Hrdlicka was probably the first to attack the Replacement theory. In 1927 he presented his full argument against Neanderthal replacement in his Huxley Memorial Lecture, and repeated again in 1930 (95). Hrdlicka viewed human evolution from a biological perspective of adaptation to selective pressures and did not see adequate reasons why the archaics, such as the Neanderthals, would have been replaced on the basis of selective pressures by another species of humans who lived around them for thousands of years under the same environment. He noted several problems with the prospect of archaic Homo sapiens (such as Neanderthal) replacement by modern human forms. Since then, it seems that there is ongoing battle between the proponents of Recent African Origin and Multiregional model. We shall touch upon this controversy a little later.

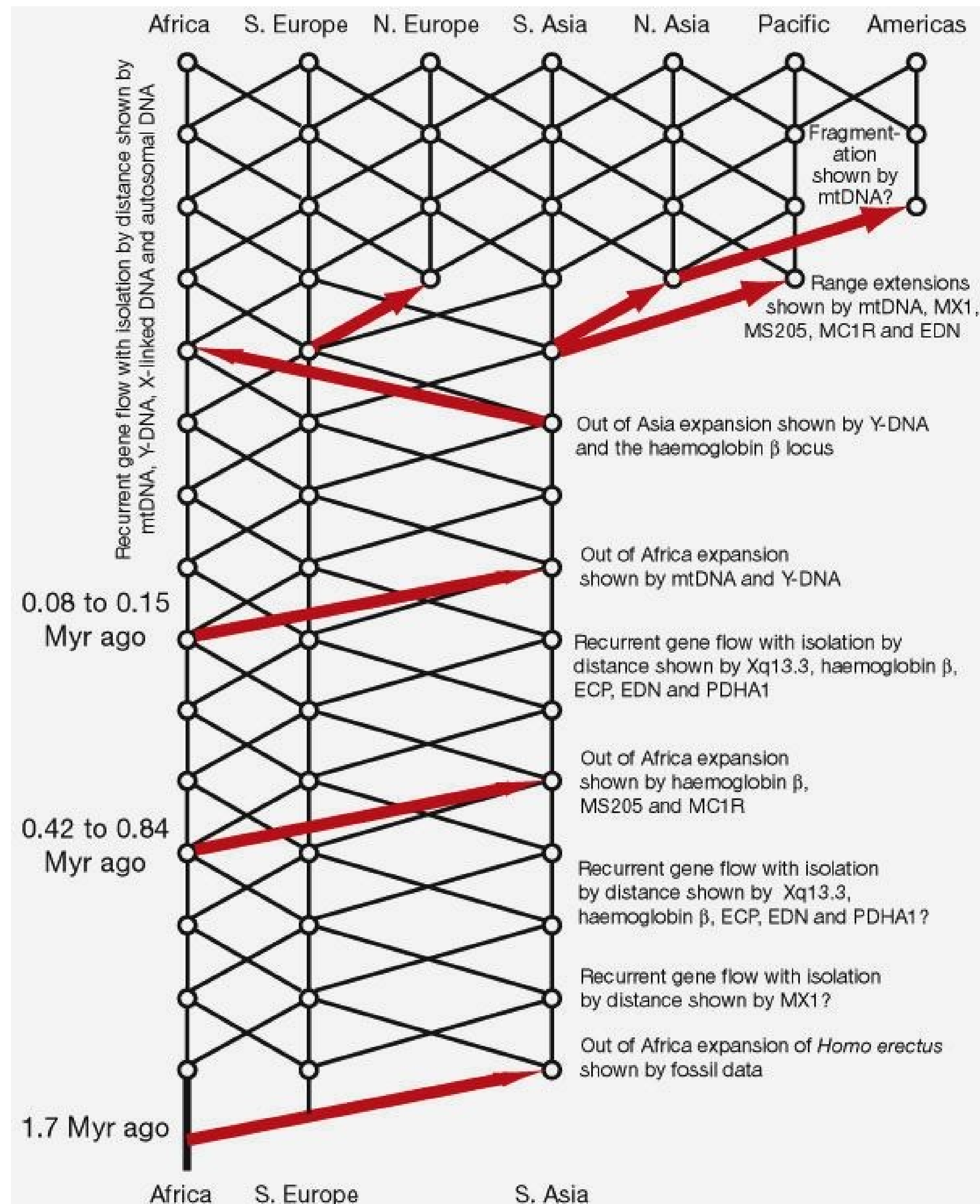
The Out-of-Africa model draws its strength from molecular genetics. But, the interpretation of our genetic archives is a difficult science. One conundrum is trying to tease apart the influence of time and population size. It is clear from literature that individual investigators can look at the same set of data and arrive at very different conclusions. In fact, the sheer volume of post-1990 publications should remind us that the genetic evidence is not as cut-and-dried as it is commonly presented to be. mtDNA studies are often offered with a degree of certainty as the laws of physics and chemistry and are sited as such, that is, ‘scientific’. The fact may, however, be different.

Multiregional Hypothesis: The roots of Multiregional Model for the emergence of modern humans are to be found in Weidenreich’s polycentric views (96) but in its present form the model was

***They (the multiregional hypotheses) are based on the basic assumption that human evolution was a continuum in time as well as in space, which means that the modern man may have first evolved in Africa but it did not spread by multiplying within itself, rather by assimilating with the pre-existing hominins in Africa as well as in other continents.* In other words, all the conventional species of the genus *Homo* was one species from the very beginning, differing only in a few superficial, mainly adaptive, features. This super-species evolved collectively and concurrently in Africa as well as in different parts of Eurasia and is now represented by us, the Homo *sapiens sapiens* of different races and regions.**

mainly formulated by Wolpoff and Thorne. The Middle and Late Pleistocene fossil human record

from East Asia has played a pivotal role in developing this model. The supporters of Multiregional evolution trace differences in a number of specific regional morphological complexes to ecological and demographic factors associated with the initial radiation of Homo *erectus*, the so-called center-andedge perspective (134). Unlike other polycentric models that have been derived from Weidenreich's,



A Multiregional model of recent human evolution as inferred from a multilocus nested clade analysis. All inferences are cross-validated by two or more genes, and are statistically significant at least at the 5% level. Major expansions of human populations are indicated by arrows, along with their estimated times and 95% confidence limits using a molecular clock with a 6 Mya calibration for the split of humans and chimpanzees. Regional descent is indicated by thin vertical lines, and gene flow (mostly constrained by isolation-by-distance) among regions is indicated by thin diagonal lines. (From Templeton,

2005. Haplotype trees and modern human origins. Yearb. Phys. Anthropol. 48:33–59.).

for example that of Coon, the present-day Multiregional model does not claim that local lineages leading to modern humans evolved independently from each other. Rather, proponents of the Multiregional model assert that gene flow, in the form of both population movement (migration) and genetic exchange across population boundaries, would have prevented speciation between the regional linkages and thus maintained human beings as a single, although obviously polytypic, species throughout the Pleistocene.

The implication of this model are many. For example, Milford Wolpoff (113) argues that no single definition of modern humans will apply in all regions because of the different mixtures of indigenous and extraneous factors that occurred in different geographic regions. Second, modern human anatomical form does not necessarily have to appear earliest in Africa. Third, the earliest modern people in Eurasia will lack distinctly African regional features, since they are not the result of migrating Africans. Fourth, nonadaptive or regional clade features will be identifiable earliest in the most peripheral regions of the human range and late in the central region. Finally, Wolpoff and others have ;pointed out that there are explanations for extant human genetic variability that do not invoke a recent African origin for all modern people.

Multiregional or Continuity Model - What it is *NOT:* The Multiregional model has been much criticized, even ridiculed. A large part of this criticism is directed towards a misrepresentation, sometime bordering to a caricature, of the model. It is, therefore, necessary to define what the Multiregional model is *not*, before we describe it as to what it *is*.

Weidenreich argued that regional populations could display differences, and some local differences could persist through time in the same locality, but there is no assumption of independent, parallel Instead, consists of a single evolutionary lineage with no subbranches because humanity's geographically dispersed populations were and are interconnected by gene flow and lines of recent, not ancient, common descent due to this gene flow. The genetic implications of the original Multiregional Model bear no resemblance to the characterization given in Cann et al. (81,92) and later by so many others.

Also, despite common assertions to the contrary, Multirtrgionsal does not imply the parallel evolution of modern humans independently in difevolution.

humanity

Multiregional does not mean independent multiple origins, ancient divergence of modern populations, simultaneous appearance of adaptive characters in different regions, or parallel evolution.

ferent regions of the Old World and, as Templeton emphatically points out, the three straight lines emanating from a common base is *not* the multiregional hypothesis. Despite multiple explanations and elaboration in the past three decades, this characterization has been perpetuated even until today (97,75,100). The "Multiregional" model shown in these depictions requires a parallel evolution of non-modern humans into their modern forms. This model was already largely discredited before the publication of Cann et al. (81) just on the basis of the theoretical implausibility of such a threefold parallel evolution. Moreover, early genetic studies had already falsified this hypothesis by showing

that the genetic differences among the major populations of humanity were rather small and showed no evidence of ancient, highly divergent sub-lineages. So why was there even an on-going debate about the multiregional model so late in time? The answer is straightforward: the three-prong depiction of human evolution was *not* the multiregional model being debated at this time.

Because the advocates of the multiregional model strongly objected to the candelabra model as representing the multiregional model for its emphasis on parallel evolution due to a lack of gene flow (92), many of the subsequent authors who favored the out-of-Africa replacement model would slightly modify their tree-like figures by drawing in a few horizontal lines between the continental lineages to represent gene flow. These subsequent figures still portray human evolution under the Multiregional model as essentially tree-like with gene flow being a weak, sporadic force rather than a continuous, not sporadic gene flow, and no tree-like structure whatsoever. This visual downplaying of the role of gene flow in such figures is often reinforced by the text. For example: "Over the years, the multiregional model has been modified, and its current version - the Thorne-Wolpoff hypothesis - assumes that considerable admixture (represented by double arrows in Figure....) took place between African, Asian, and European populations as they were evolving into Homo *sapiens*" (98). However, as is clear from Weidenreich, Wolf, and many others, parallel evolution was *never* part of the Multiregional model, much less its core, whereas gene flow was *not a recent addition*, but rather was present in the model from the very beginning.

Unfortunately, such misrepresentations, including the pictorial and textual dismissals of the importance of gene flow in the Multiregional model, are found not only in books geared for a lay audience, but in scientific books as well. This evident prejudice shown by many scholars towards the Multi-regional model partly stems from the reservations that the model somehow supports the creation theory which promulgates one single source of human population.

Multiregional or Continuity Model - What it *IS*: In recent years Multiregional model for human evolution and dispersal has been largely addressed by Wolpoff, Thorne, and Wu. They take their bearings from Widenreich's "trellis" model but theirs is a much more detailed and sophisticated version. It contains the following components:

some level of gene flow between geographically separated populations prevented speciation, after the dispersal
• all living humans derive from the species *Homo erectus* that left Africa nearly two million-years-ago
• natural selection in regional populations, ever since their original dispersal, is responsible for the regional variants (sometimes called races) we see today
• the emergence of *Homo sapiens* was not restricted to any one area, but was a phenomenon that occurred throughout the entire geographic range where humans lived.

The multiregional view posits that genes from all human populations of the Old World flowed between different regions and by mixing together, contributed to what we see today as fully modern humans. The replacement hypothesis suggests that the genes in fully modern humans all came out of Africa. As these peoples migrated they replaced all on the other hand was explained by a balance of gene flow, selection and genetic drift (75,101). Wolpoff and other proponents of Multiregional Model emphasized the role of both genetic continuity over time and gene flow between contemporaneous populations in arguing that modern humans arose nor only in Africa but also in Europe and Asia

from their Middle Pleistocene forebears.

The proponents of Multiregional model contend that humans in the genus *Homo* have always been members of a single species. Although regional populations have developed distinctive regional peculiarities, they have always been connected by enough gene flow to prevent any of them from becoming reproductively isolated. The genus *Homo* has thus evolved as an interconnected web of regional lineages extending back to the earliest hominins. As expounded by Wolpoff (102), Multiregional is not monocentric; it holds that modern human anatomy did not evolve as a complex in a single region, but emerged through the consolidation of traits originating in different regions. The length of time that it took for a fully modern anatomical pattern to emerge in a particular region would have

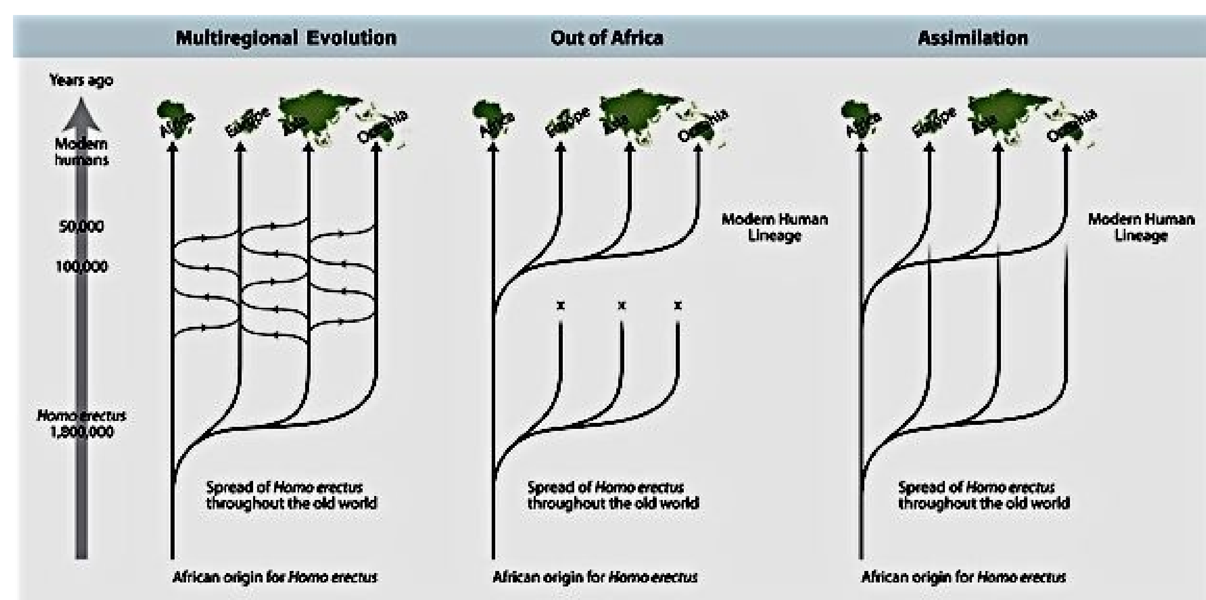


Diagram showing the two major evolutionary models and one hybrid model (*Gibbons' Nature Education, 2013***)**

other human populations with little or no interbreed
ing.
depended on several factors, including the rate and pattern of gene flow, the local selective
environThe multiregional model was first developed

to explain how some traits, such as increased cra
nial capacity and reduction of the face, could evolve
across the Old World while at the same time other
traits could retain regional distinctiveness over time,
such as the high prevalence of shovel-shaped inci
sors in past and present Asian populations. The
seeming conflict between similarity between popula
tions on one hand and regional continuity over time
ment, and genetic drift. Although local populations might occasionally have been replaced by immigrants, some archaic populations survived in every geographical region to become contributors to the modern human gene pool. The extent of archaic contribution to early modern populations would have varied from region to region.

In its most simple version, the Multiregional or Continuity Model contains the following four

components: First, all living humans derive from the species Homo *erectus* that left Africa nearly two million-years-ago. Second, after the dispersal, some level of gene flow between geographically separated populations prevented speciation, i.e., the evolution of separate species or sub-species. Third, natural selection in regional populations, ever since their original dispersal, is responsible for the regional variants (sometimes called races) we see today. Fourth, the emergence of Homo *sapiens* was not restricted to any one area, but was a phenomenon that occurred throughout the entire geographic range where humans lived. Thus, in a nutshell, the evolution of humanity throughout the Pleistocene has been within a single widespread human species, Homo *sapiens*, in response to the normal forces of evolution: selection, mutation, genetic drift, and gene flow.

It is a general evolutionary model that attempts to account for species-wide change while allowing for local and regional continuity. It is important to note that despite arguments to the contrary, multiregional evolution does not necessarily argue that the primary genetic input into any region of modern humans came from within the same geographic region. Other models are also possible within the general Multiregional framework, including major genetic changes originating within Africa and mixing, through gene flow, with non-African populations. A good example of the range of models accommodated under the general model can be found in Wolpoff et al (103).

Weidenreich's“trellis”positsgeneticexchanges not just within but also between regional lineages. Naturally, the amount of gene flow between regions would have been variable over time and space, and certain regions may have been effectively isolated at times. Early formulations of MRE seemed to imply that the movement of genes between regions probably did not involve systematic movements of populations. However, more recent statements of the theory (104) concede that migrations - for instance, the movement of modern people into Europe around 35,000 years ago, may at times have been important in fostering the spread of new genes.

Thorne's "center and edge" (104,108,111) hypothesis has played a large part in the development of recent versions of Multiregional model. Thorne applied two well-known biological principles to the study of fossil humans. The first is that polytypism - the presence of multiple modal peaks of variation within a species - will evolve in any species that has a wide range encompassing diverse ecological communities. The second is that populations on the peripheries of a polytypic species' range are usually less variable than those in the core region where the species evolved. Because the core region is the environment to which the species has been adapting the longest, it normally represents the optimal environment for the species. In such optimal environments, stabilizing selection is reduced and more variants can flourish.

From these principles - and from the plausible assumption that Africa was at the geographical center of the human story, whereas East Asia and Australasia were "edges"- Thorne reasoned that human variation would be expected to be highest in Africa. In the more peripheral environments of Eurasia, suboptimal conditions would have imposed new, harsher selection pressures, reducing variation and leading to the fixation of locally adaptive traits. And because those marginal environments would initially have been occupied by small groups, founder effect and drift would result in the random fixation of other variants. The combined effects of idvergent selection and sampling error would be expected to produce distinctive regional types - geographical races - at the periphery. Thorne argued that this pattern had always characterized human populations, starting with the initial spread of early hominins out of Africa. Thorne's reasoning was not only supported by evolutionary theory; it also explained some aspects of the fossil record (e.g., variable hominids’ morphology in Africa vs.

distinctive regional morphs in]ava and China). The centerand-edge model accordingly became a fundamental tenet of the Multiregional proponents.

Although Weidenreich's original model did not show any major population expansion events after the initial expansion out of Africa, many recent scholars admit to population expansions but these were accompanied by interbreeding and not total replacement (77,78,78,103), resulting in many current flavors of the original Multiregional model (74). By positing total replacement, the out-of-Africa replacement model renders the population structure of Pleistocene populations irrelevant, which in turn makes the replacement model simpler and more well defined than the Multiregional model. As a consequence, the out-of-Africa replacement hypothesis is actually a more appropriate null hypothesis of human evolution than the Multiregional model.

As Templeton has pointed out (109) , the multiregional model is not just a single alternative of recent human evolution, but rather is a class of models. Weidenreich (96) created this model to deal with morphological data from the fossil record, and his diagram invokes continuous and sufficient gene flow throughout the Pleistocene to explain the global evolution of modern human traits, but with the gene flow being sufficiently restricted by distance to allow some regional differentiation and continuity. Population genetic theory and observations indicate that there is a broad range of conditions that will result in this pattern (110). When gene flow is highly restricted, say by distance, local differentiation of even neutral traits is possible while selectively favored traits can still sweep through the species. When gene flow is high, neutral traits show little differentiation, but locally adapted traits can show much differentiation and continuity. Consequently, there is a broad range of gene flow and selective conditions that could explain the patterns that were of concern to Weidenreich. Accordingly, the multiregional model is really a class of models and not a single, well-defined alternative to replacement.

Of course, Multiregional model has been severely criticized by the proponents of Recent Out-ofAfrica model. A stinging criticism comes from Christopher Stringer (83) who convincingly showed that the "original" version of Multiregional Evolution was no longer tenable. Multiregional hypothesis has been challenged mainly on genetic grounds. Despite the careful arguments of Relethford, the level of gene flow required to spread the ubiquitous modern morphology under Multiregional would appear incompatible with the claimed parallel long-term maintenance of regional features in small peripheral populations.

The fossil evidence: The multiregional hypothesis was formulated primarily on the basis of fossil evidence. Advocates of this mode, primarily Milford Wolpoff (92,97,102,111,112,113,114,115), underline what they interpret as fossil continuity in the transition from *Homo erectus* to "archaic" *Homo sapiens,* and thereafter to modem humans, in China, Australasia, the Middle East, and other regions. They point out to the multifaceted similarities between the remains of the early humans and the present population inhabiting the same region and these are explained by hypothesizing that Homo *erectus,* Homo *sapiens* and other humans were a single species. The hominin fossils from Australasia are argued to show a continuous anatomic sequence, with the earliest Australians displaying features seen in Indonesia and south China 100,000 years ago. Similar evidence is seen in northern Asia. One million years old Chinese fossils differ from Javan fossils in ways that parallel the differences between north Asians and Australians of today. Similarities of morphological features between Oriental populations and fossils of modern Homo *sapiens* from the same regions, Wolpoff argues, support a regional continuity only possible within the Multiregional model. At the heart of the

Multiregional hypothesis is also the apparent similarities between the artifactual remains of the Homo *erectus* and those of the later Homo *sapiens* but this aspect has not yet been studied adequately. The replies to these arguments are, of course, offered.

And then, there is the question of South Asia, especially Pakistan and India. Here we see a remarkable continuity between the artifacts from the Middle Stone Age to the Later Stone Age and between the Later Stone Age to the Mesolithic or even the Neolithic. In spite of immense archaeological and interpretative efforts, no sign of the arrival of the modern man has been found here. Continuity in technology and its gradual change is the name of the game.

One of the more obvious inferences that can be made from the fossil record concerns the question of the time and place for the emergence of modern humans. Where and when in the fossil record do we see the first appearance of modern humans? According to a strict multiregional view, there was a gradual transition between archaic and modern anatomy, it will be difficult if not impossible to pinpoint a single point of origin. On the other hand, both the African replacement model and the assimilation model predict that anatomically modern humans appeared first in Africa and he appeared with a bang. Complicating the debate is disagreement over anatomical definitions of modernity and over geologic dates. For many years, there was suggestive evidence for a date around 130,000 years ago, although the anatomy was debated. More recently, the picture seems clearer, with evidence of early moderns in Africa at 160 00 to 200,000 years ago. Compared to these early dates, the first appearance of modern humans outside of Africa is later in time, with dates around 92,000 years ago in the Middle East, 60,000–40,000 years ago in Australia and 40,000–30,000 years age in Europe, Central and South Asia are undated as no relevant fossils of Homo sapiens have so far been found in these regions. The evidence from southern China is uncertain but if it really turns out to be 100,000 years ago, as is claimed, it opens up another Pandora's box.

Genetic Evidence: The proponents of Multirigional Hypothesis generally do not evoke genetic arguments. They do, however, point to several weaknesses of genetic evidence for the Out-ofAfrica model and strongly object to the assignment of an unwarranted priority to such an evidence, as if the meaning of pattern were uncontroversial within genetics and did not need to be reconciled with pattern in the fossils and the archaeology. It has been pointed out that while the weight of mtDNA and Ychromosome research published so far is consistent with *some* kind of recent-African-origin model, it is important to remember that the histories of particular genetic systems are not the same as population histories and that the genetic evidence as a whole does not uniquely support a recent (less than 200,000 years ago) divergence date for *Homo sapiens* or imply a speciation event, a radiation or range extension out of Africa, or a physical replacement (by whatever mechanism) of one form of hominin by another. As Clark (71) put it, there continues to be little appreciation by archaeologists and human paleontologists that molecular biology has an internal dynamic characterized by the same kinds of controversy and debate found in other disciplines.

The genetic evidence for and against the theories of replacement and continuity are very interesting in that they have become the primary focus of much current debate about the fate of the archaic Homo sapiens in general and the Neandertals in particular. The reason that genetics and microbiology have attained such a prominence in this debate is that their conclusions are readily accepted by the scientist and the layperson alike. The genetic debate began with the groundbreaking work of Cann and Stoneking in the 1980s (81,117). This work was based on examinations of the variation within mitochondrial DNA sequences in modern humans, and used several assumption on which to

determine a coalescence point for modern human mtDNA, for example:

1. Mitochondrial DNA is conserved from generation to generation without any recombination.

2. Mitochondrial DNA is passed on from mother to child without any paternal inheritance of mitochondria.

3. Since there is no natural selection on mtDNA, mutations will accumulate rapidly and at a relatively stable rate over long periods of time.

These assumptions have recently been questioned and deemed to be not necessarily true. The estimated rate of mtDNA mutation varies from study to study, and some estimates put the date of origin of modern man closer to 850,000 years ago, the time of Homo *erectus*, rather than 100,000-150,000 years ago, as commonly cited. Thorne and Wolpoff (118,119) are strident in their criticism of the ‘molecular clock’ by denying its reliability. They cite the potential for genetic drift, that some mtDNA disappears every time a generation fails to have daughters. Each lost branch alters the estimation of coalescence to a more recent date. Population size is also addressed, especially the shrinking of population in the Northern Hemisphere due to the Ice Ages. Reductions exacerbate genetic drift and loss of mtDNA types.

Some opponents of the Out-of-Africa hypothesis have rejected the genetic argument altogether, contending that the mtDNA cannot be conclusive by itself, given that mtDNA constitutes a tiny fraction of the total human DNA. Each of the two nuclear genomes of a human consists of about 3 billion nucleotides, which is about 250,000 times more than the mtDNA. Criticism of the genetic argument in favor of the replacement model sometimes also comes from geneticists themselves. For example, scientists at Oxford University found that the human beta-globin gene is widely distributed in Asia but not in Africa. Since this gene is thought to have originated more than 200,000 years ago, it undercuts the claim that an African population of modern *Homo sapiens* replaced Asian archaic *Homo sapiens* less than 60,000 years ago.

The proponents of the Multiregional hypothesis point to a recent Australian study of an ancient Aboriginal skeleton known as Mungo Man (116). Genetic tests show the mitochondrial DNA of Mungo Man to be from a mtDNA lineage with no descendants today. Yet Mungo man is an anatomically modern human and has been dated to be at least 40,000 years old. These proponents interpret the study to mean that mtDNA does not reflect ancestry or divergence times, and this interpretation is supported by the discovery that the gene is subject to natural selection.

As far as the higher level of genetic diversity in African populations is concerned, some critiques think that the argument is a bit overblown.They point to the fact that genetic diversity can be affected by population size in addition to mutation rate. Modern Africans have greater genetic diversity than Asians or Europeans: but is this diversity due to their evolutionary age or their greater population numbers during the last million years? One study showed that the diversity of mtDNA in African farming populations was greater than that in Africa's less numerous hunter-gatherer populations (107). Because no one believes agricultural peoples preceded hunters, this finding attests to the idea that population size is a critical factor in measures of genetic diversity.

It has been pointed out that the time at which modern mtDNA began to diversify does not necessarily coincide with the origin of modern human biological traits and cultural abilities: there is an

unexplainable gap of considerable time period. The smaller amount of modern mtDNA diversity outside of Africa could result from times when European and Asian populations declined in numbers, perhaps due to climate changes, resulting in several population bottlenecks.

Alternative Approaches: It is apparent from the above that both the complete replacement and the regional continuity models have difficulty accounting for all of the fossil and genetic data and that each of these two competing major hypotheses of modern human origins has its strengths and weaknesses. Genetic evidence appears to support the Replacement or Out-of-Africa hypothesis while the fossil and artifactual evidence favors the multiregional model. In the western half of Eurasia and in Africa, Replacement hypothesis seems to offer better explanations, particularly for the apparent replacement of Neanderthals by modern human population. At the same time, the Multiregional or Continuity hypothesis appears to better explain some of the regional continuity found in East Asian populations and probably those of Central and South Asia. Therefore, many paleoanthropologists have seeke to advocate views of modern human origins that combine elements of the Out-of-Africa and the Multiregional hypotheses: a few of these approaches are described below.

These efforts to formulate new syntheses or make modifications to the original Out-of-Africa as well as Multiregional models were probably forced by two significant developments since 1986. The first was the development and application of new dating techniques that could reach beyond the range of conventional radiocarbon dating *(ca.* 40,000 years ago). The second development was

Contrary to the popular belief, there is no strict relationship between the intelligence (or modernity) and the brain size, nor does it in any direct fashion

depends on the brain/body volume ratio.

the increasing impact of genetic data. In view of these developments, the two models have tended to soften their respective positions, with some recent versions of Out-of-Africa model admitting the possibility of limited admixture and gene flow between archaics and modern humans, and current statements of the Multiregionals allowing for some migration and local replacement (but not speciation). Still, all of these variations, presented in the garb of new formulations, are tilted one way or the other. Wolpoff et al. have, for example, argued that there are only two models which apply to the study of modern human and that "... there is no process that can lie between them or be a compromise." By their definition, a model that posits anything other than total genetic replacement throughout Eurasia is, by definition, a variant of the Multiregional model. However, intermediate "variants" have been proposed that involve premises that Wolpoff and other proponents of Mutiregional model reject. At least four such intermediate models have been put forward: G. Brauer's "Replacement with Hybridization" model, the "Mostly Out of Africa" model, the Assimilation model, and the Wave theory of Aswan. The first and third of these models are primarily based on the fossil record, the second is grounded in the genetic data, and the last one brings physical science of diffusion process into play.

Replacement with Hybridization Mode l: According to another version, attributed to Gunter Brauer (105,75) who was was the first to argue systematically for an early, indigenous transition to modern Homo *sapiens* in Africa and a subsequent spread of this new human form into Europe (135) and, perhaps, with less certainty, Asia as well (75). This view of the emergence of modern humans was conveniently named the *Hybridization-andReplacement Model*.

Brauer asserts that modern humans evolved from an early archaic H. *spapens* stage, primarily originating in East Africa, some 100,000 years ago, from where it expanded into Asia, populating the Near East and Europe. Brauer sees the movement of modern populations out of Africa as a gradual process, probably brought on at least in part by climatic environmental desiccation in Africa. However, he does not view modern humans as the result of a biological speciation event as the Out of Africa model does. Raher he suggests that the expanding modern populations assimilated some archaic genes into their gene pools, and therefore the disappearance of archaic human populations in Europe was the result of "replacement and hybridization". This process according to Bauer (136) ".... was certainly complex, multicausal, different in various regions and hardly rapid or complete". In Brauer's view, by far the dominant factor responsible for the emergence of modern Eurasians was the migration of African-derived populations into these parts of the Old World, *not* local continuity. Consequently, Brauer regards examples of diachronic change toward the modern human condition in Eurasin archaic groups either parallelisms or the result of stidies based on biased samples.

It should be noted that although Bauer's model (137,138,139) acknowledges the possibility of "hybridization" between modern and late archaic humans, and rejects the erection of species boundaries between them, he contends that such hybridization probably did not occur, and that if it did, its effects were negligible.

In many ways, Bauer's model is similar to the Out-of-Africa Model. Both of these suggest that the transition to modern humans occurred in Africa and that modern humans appeared in Africa earlier than anywhere else. However, this model, and other similar models discussed in the followings, differ in one very significant point from the Out-of-Africa model: while the latter strongly implies that the African origin of modern man was a *biological* speciation event (emergence of distinct species), in Brauer' views the modern man remains the same species, capable of interbreeding with the *archaics*. In this respect, Brauer thesis resembles with the Multiregional Model. Brauer's thesis, however, differs from Multiregional views in that the former is essentially African-driven view while the latter is indigenously focussed scenario. In its practical application to the fossil data, Brauer's model thus has a strong flavor of replacement - if not of species, at least of local populations.

Mostly Out-of-Africa Models: The "Mostly Out of Africa" model is supported by several geneticists. This model is like Thorne's "center and edge" concept, applied here to modern human origins rather than to Erectine evolution. Relethford is one the most lucid proponent of this model (74,140). He accepts a recent African origin for most modern human traits, both genetic and morphological, because of the probability of a larger effective population size in Africa. As he notes, this model fits the paleontological evidence as well. However, he argues that the spread of moderns out of Africa is not likely to have resulted in a total replacement of all archaic Eurasians, because of the "... findings of some non-African influence in some genes and DNA sequences as well as the fossil record for regional continuity" (140).

Templeton analyzed human genetic trees for maternally inherited mitochondrial DNA, paternally inherited Y-chromosomal DNA, and eight other DNA regions , including two on the X chromosome, and showed that there were at least three major waves of human migration out of Africa. DNA evidence suggested that these wanderers bred with the people they encountered, rather than replaced them. He combined evidence from many different populations and many different genes in an analysis to reconstruct their movement and history.

In his conclusion, Africa played a dominant role in shaping the modern gene pool through successive population expansions, and these populations interbreeding with resident populations means that genetic interchange between populations has occurred everywhere throughout history. In addition to the spread of early modern people from Africa *ca.*130,000 years ago, Templeton detected traces of two earlier migrations. The first was the initial movement of hominins out of Africa, some 1.9 million years ago. The second, around 650,000 years ago, may represent the radiation of early archaic *Homo sapiens* (a.k.a. Homo *heidelbergensis)* from Africa into Eurasia. If Templeton is correct in detecting signs of the last two of these migrations in the genetics of human populations today, then the wave of early moderns that left Africa around 130,000 years ago must have interbred with the archaics that they encountered. If they had not, then all traces of the earlier migration would have been wiped away by the last one.

Templeton’s analyses showed conclusively that the most recent out-of-Africa expansion event was not a replacement event. Replacement means the new population wiped out an existing one in Europe or Asia, resulting in their complete genetic extinction. "If it had been (a replacement event), the three significant genetic signatures of the older expansion event and the six significant genetic signatures of older recurrent gene flow would have been wiped away," Templeton writes.

It is likely that the earlier out-of-Africa expansion also was characterized by interbreeding rather than replacement, but Templeton emphasizes that the evidence for this is tentative because the probability of such old gene flow is not statistically high enough. "Humans expanded again and again out of Africa," Templeton concludes, "but these expansions resulted in interbreeding, not replacement, and thereby strengthened the genetic ties between human populations throughout the world."

EvenChristopherStringer,forlonga prominent advocate for Out-of-Africa model, seems to be convert to a ‘Mostly-African Model’ with limited interbreeding with the preexisting humans (such as Neanderthals).“I'm thinking a lot about species concepts as applied to humans, about the "Out of Africa" model, and also looking back into Africa itself. I think the idea that modern humans originated in Africa is still a sound concept. Behaviorally and physically, we began our story there, but I've come around to thinking that it wasn't a simple origin. Twenty years ago, I would have argued that our species evolved in one place, maybe in East Africa or South Africa. There was a period of time in just one place where a small population of humans became modern, physically and behaviorally. Isolated and perhaps stressed by climate change, this drove a rapid and punctuational origin for our species. Now I don’t think it was that simple, either within or outside of Africa” (Christopher Stringer in Lone Survivors).

Assimilation or Partial Replacement Model: Another versions of this middle-of-the-road hypothesis is the Assimilation (or Partial Replacement) model. This model arose through integration of the emerging evidence for an important African role in modern human origins with Multiregional views. It was developed by Smith (106), who was originally a multiregionalist. This model accepts a recent African origin for modern humans but it differs from the Replacement model in denying replacement or population migration as a major factor in the evolution of modern man. Rather, this model emphasizes the importance of gene flow, admixture, changing selection pressures, and resulting directional morphological change. According to one synthesis, humans with modern features and behavior may have first emerged in Africa or come together there as a result of gene flow with populations from other regions. These African populations may then have replaced archaic humans in certain regions, such as the Near East and Europe. Yet elsewhere - especially in the Orient and parts

of South Asia - gene flow may have occurred among local populations of archaic and modern humans, resulting in distinct and enduring regional characteristics. Smith argued that the European and Middle Eastern Neandertals, far from being overrun by the newcomers, took them in and incorporated their genetic advantages.

The Assimilation Model was first formally proposed by Smith and colleagues in 1989, although aspects of it had been put forward in earlier work. Like Multiregional , Assimilation acknowledges an important role for gene flow between archaic and modern humans in Eurasia and rejects a separate specific status for Neandertals and other Middle and Late Pleistocene archaic hominin groups. But when the Assimilation Model was first articulated, it clearly differed from Multiregional Model on three important points: (1) a relatively recent African center of origin for anatomically modern humans, (2) the pattern of spread of early modern human morphology; and (3) the extent of regional continuity across Eurasia.

In contrast to Multiregional, Assimilation accepts that modern human morphology evolved as a complex in Africa. The dating and morphological pattern of the African Transitional Group shows that this transition was underway by 250,000 years ago. If we accept the dating of Omo Kibish and Herto to >104,000 and <196,000 years ago, respectively, a complicated pattern of population migration and demic diffusion spread modern human morphology into the rest of Africa as well as into the Levant (at *ca.*100,000 years ago), and then later into Asia, Europe and the rest of the world. While this is all fundamentally compatible with Out-of-Africa, Assimilation posits that indigenous archaic populations were not totally replaced throughout Eurasia - or for that matter in the African peripheries - by the radiating moderns. Rather, interactions between these early moderns and aboriginal archaic peoples included some degree of biological admixture - at least some of the time and in some places.

ThusbothMultiregionalandAssimilation agree that there is evidence of regional continuity across the archaic/modern human boundary throughout Eurasia. The distinction here is a matter of degree. While Multiregional is not always specific as to the extent of continuity in Europe, Australasia, and East Asia, it implies that regional archaic contributions to early moderns in those regions may have been on the order of 50% (141) or more, and that these large contributions are reflected in relatively large numbers of regionally distinctive features. By contrast, Assimilation proponents have consistently argued that evidence of continuity is found only in limited numbers of anatomical details.

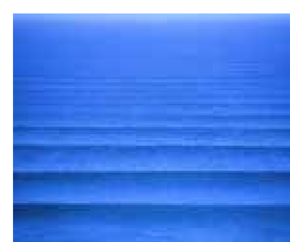
Assimilation accepts that the relative morphological homogeneity of modern humans reflects the emergence of the modern-human morphological complex in one region and its subsequent spread to other regions *as a complex*. Nevertheless, in southern and northern Africa, East Asia, Australasia, and Europe, early modern populations retain a few morphological characteristics that evidently derive from local archaic peoples.

Assimilation also fits the arguments made by the geneticists who advocate a "Mostly Out of Africa" model of modern human origins. Although most recent human genetic variation has a relatively recent African origin, such nuclear DNA polymorphisms such as the betaglobin cluster, show distributions that are not compatible with the wholly African origin envisioned by advocates of Out-of-Africa Model. While this evidence derives from relatively few genes, it does suggest that a total replacement of all archaic peoples is unlikely.

Genetic data provide no evidence of the level of Eurasian regional genetic continuity that one might

expect with Multiregional. However, this is not necessarily a decisive objection to the MRE model. The predominance of African haplotypes in living humans may result from the fact that Africa had a larger effective population size throughout most of the Pleistocene than Eurasia. Following the initial expansion of modern humans out of Africa, continued gene flow from the larger African populations would be expected to have enforced greater proportions of African genes everywhere else. In time, continuing gene flow out of Africa could have produced a genetic picture indistinguishable from one of near-total population replacement. Even if a great deal of local genetic continuity was at first present in early modern human populations in Europe or Asia, the local gene pools may eventually have been swamped by gene flow out of the larger populations in Africa. This sort of process may have been going on for a long time, if Templeton (see below) has correctly identified allelic signals of previous migrations out of Africa, assimilated into the gene pools established by the last big African emigration around 130,000 years ago.

We conclude this heading with Fred Smith's own words (145): " Obviously, we are of the opinion that a model that recognizes an important role for local continuity is the best explanation for modern human origins. Unlike some proponents of Multiregional evolution, however, we are inclined to accept the idea that significant genetic exchange was probably involved in the emergence of modern hu



man anatomical form. Likewise, while we do not deny the theoretical possibility that this change could have occurred independently in different regions of the Old World, present evidence suggests to us that it is more logical to view this change as having occurred initially in one region and then to have spread throughout the Old World. We differ with both "Out of Africa" models, however, in that we do not view this spread as always playing the very minor role these models assert. We perceive our perspective on modern human origins to be theoretically closer to Multiregional than to the more replacement-oriented models. However, referring to it as Multiregional senso strict is somewhat less leading. We would describe our perspective as an assimilation model, since it involves assimilation of new elements into existing gene pools or, in some cases perhaps, old elements into new gene pools. It goes without saying that we believe such a model fits the paleoanthropological evidence better than other models, particularly those that emphasize replacement. Thus, we are not convinced that biological reality is best served by thinking of the origin of modern humans as the result of speciation in either a biological or evolutionary species concept sense. Since we do not view the origin of modern human anatomical form as a speciation event, we feel justified in continuing to use such terms as archaic Homo sapiens and modern Homo sapiens".

Diffusion Wave Model: Those of us who are uncomfortable with the idea of 'modern humans' emerging as a kind of super-species separated as a closed group from the biological and technological inheritance of the earlier regional populations

or find other alternative explanations unsatisfactory, may find Cavalli-Sfroza's *Demic Diffusion model* a lot more comforting. Demic diffusion is a demographic term referring to a migratory model

developed by Cavalli-Sforza, that consists of population diffusion into and across an area previously uninhabited by that group, possibly, but not necessarily, displacing, replacing, or intermixing with the preexisting population (e.g. as has been suggested for the spread of agriculture across Neolithic Europe, and what occurred with the European colonization of the Americas).

This model has recently been beefed up by Eswaran and made applicable (77,105) to the dispersal of particularly ‘advantageous’ traits among evolving human populations in Africa and Eurasia. Eswaran proposed a process in which the modern human phenotype originated in Africa and then advanced across the world by *local* demic diffusion, hybridization, and natural selection. While the multiregional model of human origins posits a number of independent single locus selective sweeps, and the “out of Africa” model posits a sweep of a new species, Eswaran proposes the intermediate case of a phenotypic sweep.

Summarizing Eswaran's argument here in simple language, it proposes that the worldwide transition to an anatomically modern human form was caused by the diffusive spread from Africa of a genotype - a “co-adapted” combination of novel genes - carrying a complex genetic advantage. It is suggested that the movement out of Africa was not a migration in a classical sense but a 'diffusion’, like ‘waves in the ocean' - a continuous expansion of modern populations by small random movements, hybridization, and natural selection favoring the modern genotype. It is proposed that the modern genotype arose in Africa by a ‘shifting-balance’ process (originally proposed a long time ago by Sewall Wright) and spread by directionally random demic diffusion, but only under conditions involving a low rate of inter-deme admixture ('interbreeding') and strong selection. Eswaran used mathematical concepts that govern the mechanism of molecular diffusion in physics. The extrapolated data indicate significant genetic assimilation from archaic human populations into modern ones. A morphological advantage of the modern phenotype - possibly reducing childbirth mortality- is proposed as the cause of transition.

We close this discussion by quoting from John Relethford (140): “Although the modern human origins debate continues, there are signs of agreement on some general points, and it is clear that genetic data, from both living populations and from ancient DNA, have played a major role [in this debate]. Both geneticists and paleoanthropologists have increasingly accepted an initial African origin of modern humans. At present, the fossil evidence points to an earlier appearance of modernity in Africa than elsewhere, and a variety of genetic analyses also support an initial African origin, although this pattern is not as clear because of the strong possibility of a larger long-term effective population size in Africa and its subsequent effects on patterns of genetic variation. Although debate continues, there is also growing realization that while Africa may have been the primary source of our ancestry, it might not be the only one (50,110,146). Elsewhere I have suggested that modern human ancestry can be described as mostly, but not exclusively, out of Africa (74). Much recent research has been directed at the quantification of how much nonAfrican archaic ancestry exists. Some recent syntheses of the fossil record and genetic evidence make a strong case for the assimilation of nonAfrican archaic genes into the modern human gene pool (76)”.

Where Do We Presently Strand? Though Dennell (3) makes the case that modern humans may have speciated in Eurasia, the most parsimonious reading of the genetic and fossil evidence indicates that modern humans first arose in Africa. This view is the result of a synthesis of evidence from recently discovered fossils and from the study of human nuclear and mitochondrial DNA. There are, however, many dissenting voices, some of them really strong. No major claims regarding the evolution of

modern humans have gone uncriticized. Interpretations of human fossils have been vigorously contested and bitter criticism towards genetic data abounds. There are criticisms directed against the reliability of genetic trees, and also of hypotheses related to the location of the root as well as the date of the root of the human mtDNA tree. Similarly, the origins of modern humans through millions of years of interbreeding between various population groups in different parts of the world and evolving as a single world-wide species is vigorously contested. Beyond the technical problems with the genetic and archaeological methods, there is a difference in theoretical orientation that allows all sides of the debate to use the variation in modern populations as evidence that supports their respective theory. Different assumptions are inherent in every interpretation of the data and even in the way the data is extracted, prejudicing the data one way or the other.

Most supporters of Continuity model have taken up the cry of, "Follow the fossils", as they seem to be far more supportive of continuity than the genetic data. The Replacement model is strongly supported by genetic evidence and the findings of this discipline generally appear more ‘scientific’ than the results of the fossils analysis. While there is some limited correspondence between the DNA evidence and the fossils evidence, the former often clashes fundamentally with the latter.

An initial African origin is compatible with the genetic evidence. This does not mean, however, that the evidence necessarily rules in favor of the African replacement model. Instead, the debate has shifted for many to one of replacement versus admixture. In other words, the questions is being asked without any reference to the pathways of evolution: what happened to the archaic populations that lived outside of Africa when they encountered modern populations from Africa? Did they become extinct, or was there some genetic contact? If there was gene flow, then was the disappearance of archaic humans a consequence of gene flow between local archaic populations and the newcomers, resulting in hybridization between species, or perhaps different forms of admixture in different parts of the Old World?

There is suggestive fossil evidence for genetic mixture of archaics and moderns. Some anatomical traits are persistent over time, tending to occur more often in certain geographic populations both past and present. This regional continuity is frequently cited as evidence for a genetic contribution from archaic populations, although others have argued that it might represent the retention of traits from a shared ancestor of archaics and moderns together. This is not the basic tenant of the Replacement theory, but some researchers do allow a limited mixture and hybridization.

In spite of trying to bridge the gap between the two extreme positions, most of these middle-ofthe-ground theories are, nevertheless, strongly tilted to one way or the other. For example, Alan Templeton (44) reported that a computer-based analysis of 10 different human DNA sequences indicates that there has been interbreeding between people living in Asia, Europe, and Africa for at least 600,000 years. Now, such a long period of interbreeding is nothing but a Multiregional hypothesis by another name. Similarly, the various versions of hybridization and assimilation model also converge with the Multiregional model in one fashion or the other. Even the Demic Diffusion model is not truly neutral: it strongly tilts to the Multiregional direction also.

Out-of-Africa and Multiregional models have different implications for the systematics of the genus *Homo*. Out-of-Africa encourages its supporters to see the genus *Homo* as containing more species than traditionally thought, whereas Multiregional leads logically to the conclusion that all members of *Homo* should be lumped into one species. As we might expect, proponents of Out-of-Africa models

are continually on the lookout for autopomorphies in regional groups that can be interpreted as signals of reproductive isolation. Conversely, Multiregional supporters are eager to find long-lasting regional traits that demonstrate morphological continuity within specific regions over hundreds of thousands of years. Both groups want to identify regional peculiarities of morphology in fossil *Homo*, but they differ in the durations and taxonomic meanings that they assign to the persistence of those regional traits. Not surprisingly, these divergent views lead to different readings of fossil human anatomy.

After all is said and done, the two competing positions and their variations acknowledge the strong biological unity of all people. In the Multiregional hypothesis, this unity results from hundreds of thousands of years of continued gene flow among all human populations. According to the Outof-Africa hypothesis, biological unity among all living human populations result from a recent common origin. The compromise positions accept this basic imperative and allow both of these as reasonable and compatible explanations of modern humanity.

Neither Brauer's nor Smith's compromise was fully embraced, nor can it be said that there's anything near a consensus on the place of archaic humans in prehistory. But a majority of scientists would now agree that, whatever the relationship between the archaics and modern humans, the two overlapped in time and probably in place. So somewhere, most likely first in the Middle East and later in South Asia, these two kinds of people—people far more different from each other than any of today's races, yet each possessing some recognizably human characteristics—first confronted each other or interbred with each other.

Whatever the merits and demerits of various hypotheses, the absence of any concrete evidence for one or the other does not allow us to offer one or the other as fact. Nevertheless, the Out-ofAfrica model, which stipulates the appearance of modern man on the scene as recently as 150,000 years ago in Africa and spreading throughout the Old World at the expense of the existing *Homo* populations around 40,000 to 60,000 years ago, is widely accepted by the mainstream academic community. In the following chapters, therefore, we shall refer to this scenario quite often. The reader should, however, be on guard, knowing full well that the Out-of-Africa hypothesis, although widely accepted, is just a hypothesis and serious doubts exists about the validity of this model beyond the Near East and Europe. Furthermore, archaeogenetics is relatively a new field in the service of prehistory, its assumptions are not yet fully tested, and its area of observation is rather limited. Thus, even these methods may appear more 'scientific', they are nevertheless in their infancy. If personal opinions have any merit in such a discussion, the present author strongly favors the continuity theory of human evolution rather than replacing the existing populations by a certain species originating recently in Africa. We have to contend with the mechanism of the advent of modern man in South Asia and beyond. Here, we need to explain the absence of any radical change in artifactual record, mainly lithic tools, in Pakistan and India due to the 'arrival‘ of the behaviorally modern man. There are also questions of the dating of the 'arrival' of modern man in southeast Asia and China. Intuitively, the evidence does not correspond with the recent African origin of man. We need to toe this line of belief because most of the scholars want us to believe in the African point of origin.

Summary: In this chapter we discussed at some length the conventional and well-accepted Recent African Origin or Replacement model of man's African origins and his dispersal in the Old World. The commonly held view of the proponents of this model is that there was a speciation event around 150,000 years ago in the evolutionary history of man that resulted in the emergence of anatomically

modern humans in Africa. This was followed, it is proposed, by a migration of a small band of these modern humans out of Africa and the subsequent replacement, with little or no genetic admixture, of all non-African archaic peoples. Although the routes of movement differ and the timing of the arrivals in different regions of the world varies in different versions of the hypothesis, the basic premise remains the same: physical migration of human bands from one place to another, replacing the existing populations, colonizing the new land, moving to the next territory and repeating the process all over again. The whole process is, of course, generational.

The standard Out-of-Africa model utilizes the commonly understood genealogical tree approach. It also depends on identifying the various mutation points and assigning them a chronology which is arrived by utilizing a 'genetic clock', i.e., by determining time of the 'most recent ancestors' or coalescence points in happily migrating and breeding 'modern' human populations.This view received strong support from genetics during the last three or four decades and it appeared as though the issue has finally been settled. Subsequent data from the nuclear genome, however, failed to entirely support this model. These studies also failed to support any other simple model of human demographic history. Added to these difficulties are quite a few points of archaeological and anthropological points that simply do not fit in the overall picture of the Out of Africa theory and coastal migration. Some of these difficulties have been briefly reviewed in the foregoing chapter.

In this vacuum, several alternative versions, primarily based on Multiregional hypothesis or its different variations, have seen resurgence in recent years. These hypotheses do not depend on the conventional concept of migration, replacement, and colonization but envision a genetic continuity from Homo *erectus* to Homo *sapiens* or from the archaic to the modern. They are based on the basic assumption that human evolution was a continuum in time as well as in space, which means that the modern man may have first evolved in Africa but it did not spread by multiplying within itself, rather by assimilating with the pre-existing hominins in Africa as well as in other continents. Although differing in details, these proposals agree on one point: modern humans, as we encounter them presently, may not have originated in Africa alone, they are instead a product of intermixing, assimilation, interbreeding, and hybridization with the archaic humans inside and outside Africa. In other words, all the conventional species of the genus *Homo* was one species from the very beginning, differing only in a few superficial, mainly adaptive, features. This superspecies evolved collectively and concurrently in Africa as well as in different parts of Eurasia and is now represented by us, the Homo *sapiens sapiens* of different races and regions.

Speaking in technical parlance, the multiregional model proposes that modern humans evolved from regional populations that were initially created by the *ca.* 2.0 million-year-old expansion of Homo *ergaster* or homo *erectus* from Africa and that humans evolved as a single polytypic species united by a worldwide pattern of gene flow and migration.The standard version of the model asserts that modern humans originated through the coalescence of a series of modern traits that appeared independently in various areas at different times.

Few scientists still hold a banner for a strict interpretation of multiregionalism but modified versions are common, mostly as attempts to pinpoint whether Homo *sapiens* bear genetic signatures of our encounters with hominin cousins. For example, the so-called *assimilation* version of the Multiregional evolution model, proposed by Smith accepts an African origin for modern humans but suggests that diffusive gene flow - involving localized population movements, admixture, and selection - spread the advantageous genes associated with modern humans to other populations and

initiated their transition to anatomical modernity. However, few of the hybrid fossils expected in this scenario have been found outside Africa, and this has led to some doubt regarding the model. A more rigorous version of Multiregional evolution and dispersal is that of Eswaran. He pictures human dispersal as a process of demic diffusion into and limited interbreeding with the pre-existing ‘archaic’ or ‘mixed’ populations, selectively propagating some advantageous traits through a series of diffusional waves. The concept draws upon the theoretical treatment of Luca Cavalli-Sforza which he advocated for the spread of the Levantine farmers in Europe. Eswaran also relies heavily on the theory of *shifting balance* proposed by Sewall Wright a long time ago. It is an interesting concept but quite heavy in theory. The hypothesis, therefore, needs considerable attention to follow its thought process.

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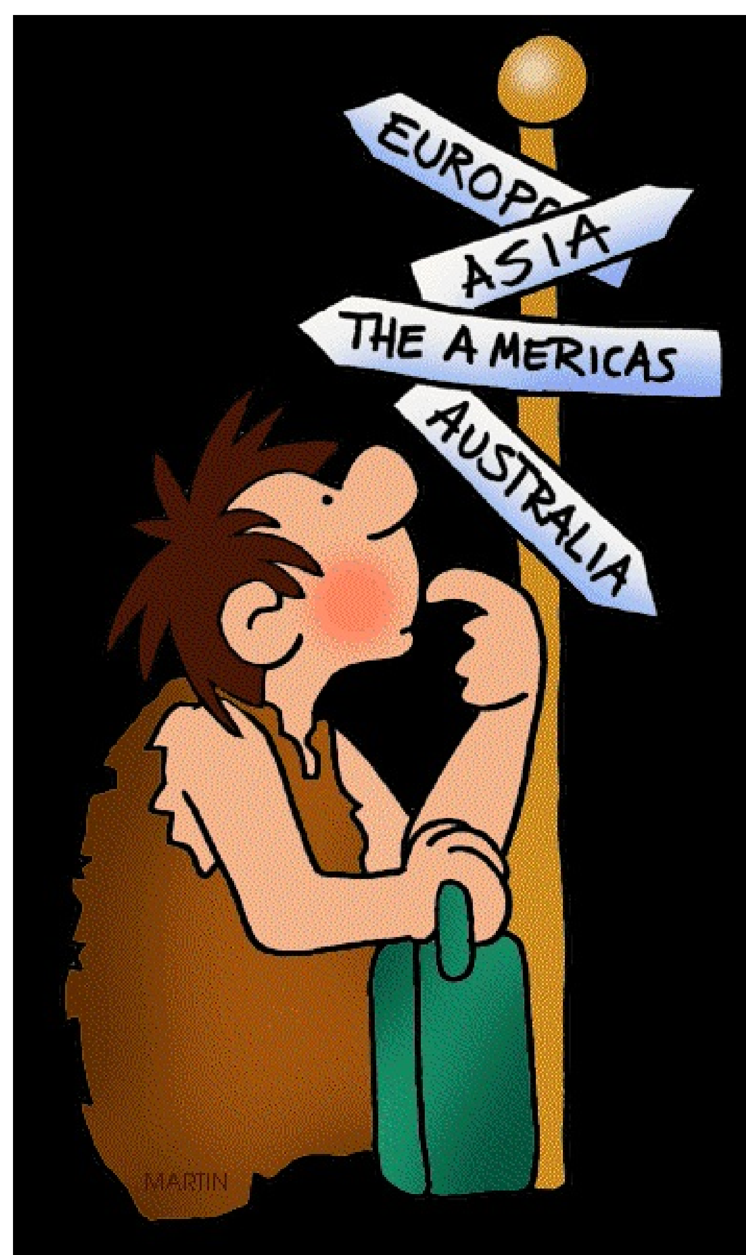
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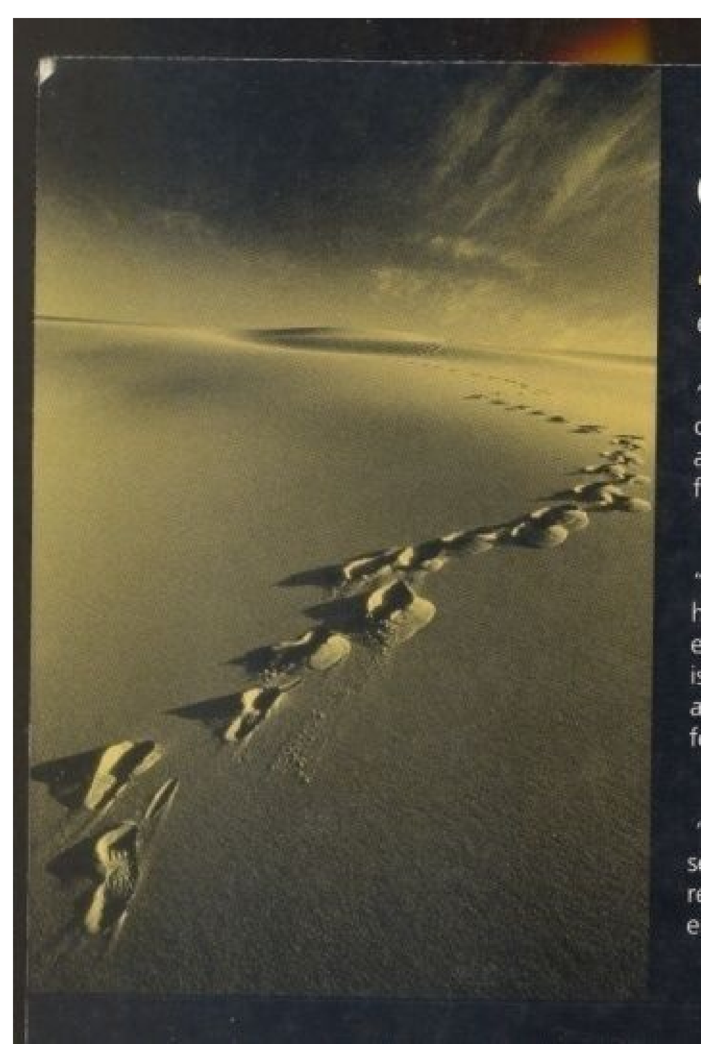
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Dispersal of Humans and Peopling of Pakistan



III.1 Human Dispersal - A conventional View III.2. Human Dispersal - A MulJregional View III.3. Human Dispersal in Pakistan III.4. References

III.0. Human Dispersal and Peopling of Pakistan



Where, when, and how did modem humans first appear in ancient Pakistan? How did they spread throughout the Greater Indus Valley and beyond? Furthermore, what happened to those who lived there before them? Where did this population go? Did the archaic humans of Pothwar disappear from the face of the earth, or did

they evolve into modern humans? Did they interbreed with the newcomers, whosoever they happened to be? To which "race" of mankind did these ancient people belong? Who were their ancestors? How did they evolve? Did the human bands working the mesa of the Rohri Hills and drinking the water of the Indus River differ from those who roamed about the Pothwar Plateau and bathed at the Soan? Did the cave dwellers of the Peshawar Valley had any relatives living across the Hindu Kush and the Pamirs? Were the people who inhabited the plains of Lasbela related to those who populated the fringes of the Thar? Did the peoples of Cholistan Desert had anything in common with those inhabiting the hills and valleys of Baluchistan? And, did the genes of the 'modern humans' diffused into Pakistan through the Pashtum country in the northwest or through the coastal Sindh in the South? Not the least, how were they related to those who lived in the Arabian peninsula and Central Asia?

These are tantalizing questions and satisfactory answers to them may not be found. The difficulty of answering them adequately lies in the fact that we have practically nothing to base our speculation on: no human fossils, no bones, no camping sites; only a bunch of stone tools spread all over the land. We are also not lucky to find much of the related evidence in the neighboring lands beyond the discovery of a fossilized human skull in the Narbada Valley in India and a few bones in a cave in

Afghanistan, belonging to comparatively recent times. Nevertheless, since the questions are important ones, we ought to address them, or at least speculate on them.

The question of the peopling of Pakistan is intimately connected with the evolution of man and his spread in the Old World; it can, therefore, be addressed only in a broader context. As has been shown in the previous Section, the making of man was an evolutionary process, involving the development of body and brains; and of manual, social and intellectual skills, which decisively distinguished humans from the rest of the animal world. This process was a long one, extending over several million years, and there are more than one line of interpretations for this process. In view of this long and tortuous process and the ever changing interpretations of fossil record and genetic readings, the tracing of the colonization history of any region would be a difficult task. So is it with Pakistan.

This Section attempts to survey how the human race is thought to have populated Eurasia and how South Asia in general and Pakistan in particular fit in this equation. This is, in effect, a continuation of the topic that formed the body of the last Section, i.e., *In Search of Adam*. Here we are primarily concerned with the dispersal of 'modern man' over the globe and his colonization of Pakistan, but the question of the archaic humans and their ancestors who populated this land prior to its colonization by the modern man cannot be ignored. This phase in the ancient history of Pakistan is as important as that related to the anatomically modern humans. After all, 'modern human' may not be an exclusive breed.

Pakistan is situated at the heart of Eurasia and any sizable movement of humans from their presumed place of origins, such as east Africa, to anywhere in East Asia must pass through this region. This central geographical place also dictates that we take into account the genetic and cultural influences that may have emanated from the surrounding area and have impacted the process of the first colonization of this land. The study of the initial colonization of India, Iran, and Central Asia thus becomes quite relevant to Pakistan's Stone Age history. Some of it has been briefly tackled in the last Section, some will be dealt with in the following pages as the occasions arise.

The spread and dispersal of humans in the Old World is a fascinating subject and, as judged from the number of publications coming out in recent years, is vexing the minds of a host of archeologists, anthropologists, archaeogeneticists, and students of ancient history. By the same token, it is a complicated subject, full of speculation, fancy theories, good and bad science, and a lot of controversies, not to speak of abundant biases, and plenty of missionary zeal.

The subject discussed in this Section is largely an undertaking of Paleoanthropology. Paleoanthropological studies are rather late in this part of the world and there can be no question that, as a consequence, Africa, the Far East, Europe, and Australia-Oceana have contributed more fossil evidence for elucidating human origins, evolution, and dispersal than South Asia. But, recent discoveries and academic interest in the dispersal of early hominins and modern humans are slowly breaking this barrier. This heightened interest in the paleoanthropology of South Asia probably stems from the possibility that hominins may have occupied large parts of South Asia by more than two million years ago, rather than the substantially later date of around one million years ago so far believed.

The doubling of the antiquity of early humans in South Asia has been brought about by a handful of new discoveries and the re-dating of older ones. New discoveries in Pakistan include the intentionally flaked stones recovered from Riwat and Pubbi Hills in a temporal horizon that has been dated by both

the discoverers and independent geological teams to the late Pliocene, *ca.* 1.9 to 2.1 million years ago and more than a million years go, respectively. The discoveries of stone artifacts and human fossil remains from northern Afghanistan and central India provide the continuity of human presence in the region.

The discussion on the dispersal of 'modern humans' can be extremely controversial. On one hand we can discuss the subject believing that modern humans recently originated in Africa as a unique species, from where they spread all over the world, displacing all pre-existing 'archaic' humans. Or, we can approach the topic on the basis of multiregional origins of man, according to which the human evolution was not restricted to Africa but, instead, it covered the whole Old World; that 'modern human' did not emerge as a unique biological species in Africa or anywhere else but, instead, it represents only an end-product of a very long evolutionary process, starting at least 2.5 million years ago, in which all parts of humanity took part as one single entity.

The implications of each scenario are obviously different. In the former case, human migration and construction of genetic trees, as implied in the last Section, take the central stage. In the latter case, the concept of genetic tree completely vanishes and the significance of human migration becomes only marginal. In their place, genetic interaction becomes the main driving force, and the progression of gene flow becomes the sought-after result. We are approaching this discussion here mainly from the point of view of the former model but also present the human dispersal from the point of view of the Multiregional model, of which Eswaran's Diffusion Waves is one recent version. There is no real correspondence between these two approaches but we may note two common points, namely: both approaches admit to the African origin of modern humans (one on the level of speciation and one on the level of only a sub-species) and both strive to see the dispersal of the 'modern' features at the expense of the pre-existing 'archaic' way of existence (one through physical migration and elimination, the other through genetic compulsions). In this respect, quite a few conclusion drawn from the former can be applied to the latter.

In case we subscribe to the generally accepted Out-of-Africa model for human evolution, the dispersal of humans necessitates the visualization of particular routes, which human bands may have ostensibly taken to migrate from East Africa to every nook and corner of the Old World. Since this perceived migration was generational in scope and the peopling of continents was the result of a prolonged process, one needs to know the timing of various movements, forking of ways, and the re-merging of routes. Fossilized skulls of early humans, found here and there outside Africa, are of some help to us in this enquiry. Stone artifacts and other archaeological finds are equally useful.

The origins of the genus *Homo*, in Africa, is not in doubt. Similarly, there is a near consensus about the origins of Homo *sapiens sapiens*, the modern man, in East Africa. Assuming East Africa to be the cradle of humanity, one of the more popular issues being addressed within the academic community is the nature and timing of various dispersal events from East Africa to other parts of the Old World. Question has also been raised: was the dispersal of modern humans from East Africa a physical migration of a small band of people who multiplied as they spread over the whole length and breadth of Earth, replacing the archaic humans everywhere they went; or the dispersal event was merely a continuum of human evolution through inbreeding with and among the pre-existent archaic humans. Did modern humans really disperse over the face of Earth through a commonly understood process of physical migrations of human bands, or were the *traits* of modern human that dispersed through a process by which some particular sets of modern genes spread among the pre-existent populations in

the form of a multiple of diffusion waves? These are the questions of utmost theoretical interest.

The study of fossils and chipped stone tools is essential in exploring the human past but perhaps the most important tool in this enquiry is the population genetics. The genetic composition of the current populations of various regions and continents reveals a lot in matters of dispersal and migration of modern humans. Most of the discussion on the dispersal of modern humans, therefore, revolves around the analysis of human DNA.

In the past three decades, a wealth of genetic data has been made available from YChromosome DNA (inherited through males), mitochondrial DNA (inherited through females) and autosomal (biparentally inherited) DNA of the present day populations of the world. These data have been used to compare the DNA of diverse human populations in ever greater detail and to develop phylogeographic studies to map ancient dispersal events. These studies are providing us with a sound basis on which we can build a rudimentary edifice of reason and informed speculation. As it reaches a critical mass, it should provide us with some clues to the spread of humans in ancient Pakistan and the interaction of diverse population groups in its distant past.

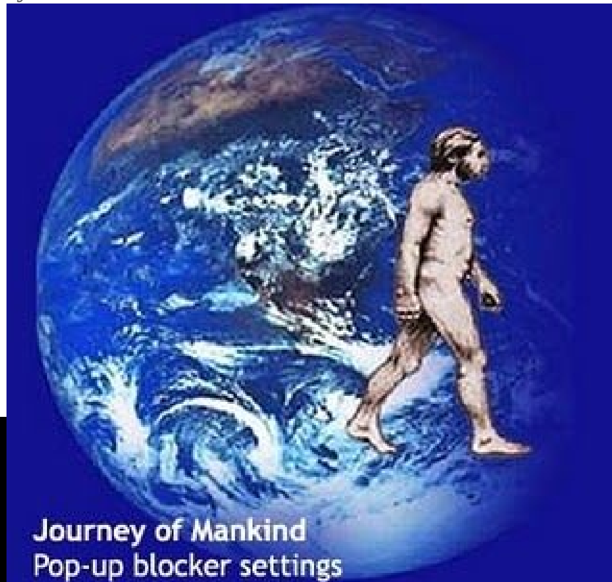
Pakistan sits at the center of the region which is supposed to be the primary playground of early humans as they spread from East Africa to Southeast Asia. It is also a bridge between the vast territories of Central Asia and equally vast areas that we call India. It is evident that Pakistan happens to be at the crossroads where several migratory waves of the early as well as later humans must have met or crossed each other’s paths. The genetic origins and demographic history of Pakistani populations is, therefore, important both for questions concerning the early settlement of Eurasia and more recent events, including the appearance of Indo-European languages. It is an involved and complicated subject but interesting nonetheless.

Share

III.1 Human Dispersal - A conventional View

Gallimaufry

A SHORT HISTORY OF HUMAN MIGRATION {with ref: to- INDIA & migration & Bombaycity}
DNA studies suggest that all humans today descend from a group of African ancestors who—about 70,000 years ago—began a remarkable journey.



This chapter explores the human dispersal in its general aspects and discusses such questions as to when did man and his ancestors left Africa, where these migrants may have gone, how did they get

there, and what may have happened to them when they arrived; all of this, of course, with reference to the peopling of South Asia in general and that of Pakistan in particular. Some aspects of this subject have already been touched upon in Section II: this Chapter fills in the remaining gaps.



Assuming that first early hominin, such as Homo *erectus*, originated in Africa sometime around 2.5 million years ago and the first modern man, also in Africa, emerged between 100,000 and 150,000 years ago, we approach the subject of early human dispersal in two stages: At one level we are interested in the dispersal of early humans, such as Homo *erectus*, archaic Homo *sapiens*, and other pre-modern species which may have existed on regional basis in Eurasia. On the other level, and probably of much more relevance to the present discussion, is the evolution and dispersal of Homo

sapiens sapiens, the anatomically and behaviorally modern man, populating most of the livable space on Earth since, say, 100,000 years onward.

Since enough has been said on the evolution of early hominins in Africa, their exodus from Africa some 2 million years ago, and their subsequent spread in Eurasia, we shall atempt here to further the discussion from the point of view of modern humans, the Homo *sapiens*. It is felt that for the study of the prehistory of this part of the world, the debate on the origins and dispersal of modern humans is much more important than the tale of the hominins told in Section II for it is this species of genus *Homo* who eventually inherited the earth and it is its progenies that presently populate the globe.

The story of the dispersal of modern humans cannot, however, be told without a reference to the story of their ancestors. Some aspects of the evolution of hominins in Africa, culminating in the emergence of modern man, has been discussed in the last section, so has been their possible relationship with the populations of pre-modern humans in Asia. Here we revisit the subject from the point of view of the exodus from Africa and their possible strategies of dispersal in Eurasia before we go on to the main story. Some degree of repetition is unavoidable but in the interest of continuity it should be tolerated.

DISPERSAL OF EARLY HOMININS FROM AFRICA

Understanding the dispersal patterns of early hominins is a major research focus in paleoanthropology. Such reconstructions of hominin movements are essential for understanding the pattern of human evolution and for assessing evolutionary scenarios. Given the fragmentary nature of the hominin fossil record, and the frequent controversies that surround the dates of key specimens, the reconstruction of hominin dispersal patterns is often fraught with grave difficulties. One potential means of supplementing fossil evidence for dispersal events is to use archaeological evidence in the form of stone artifacts. Being inherently more resilient to decay than osseous material, fully exploiting the potential that these lithic remains might offer in order to address issues of palaeobiological relevance, is an important goal.



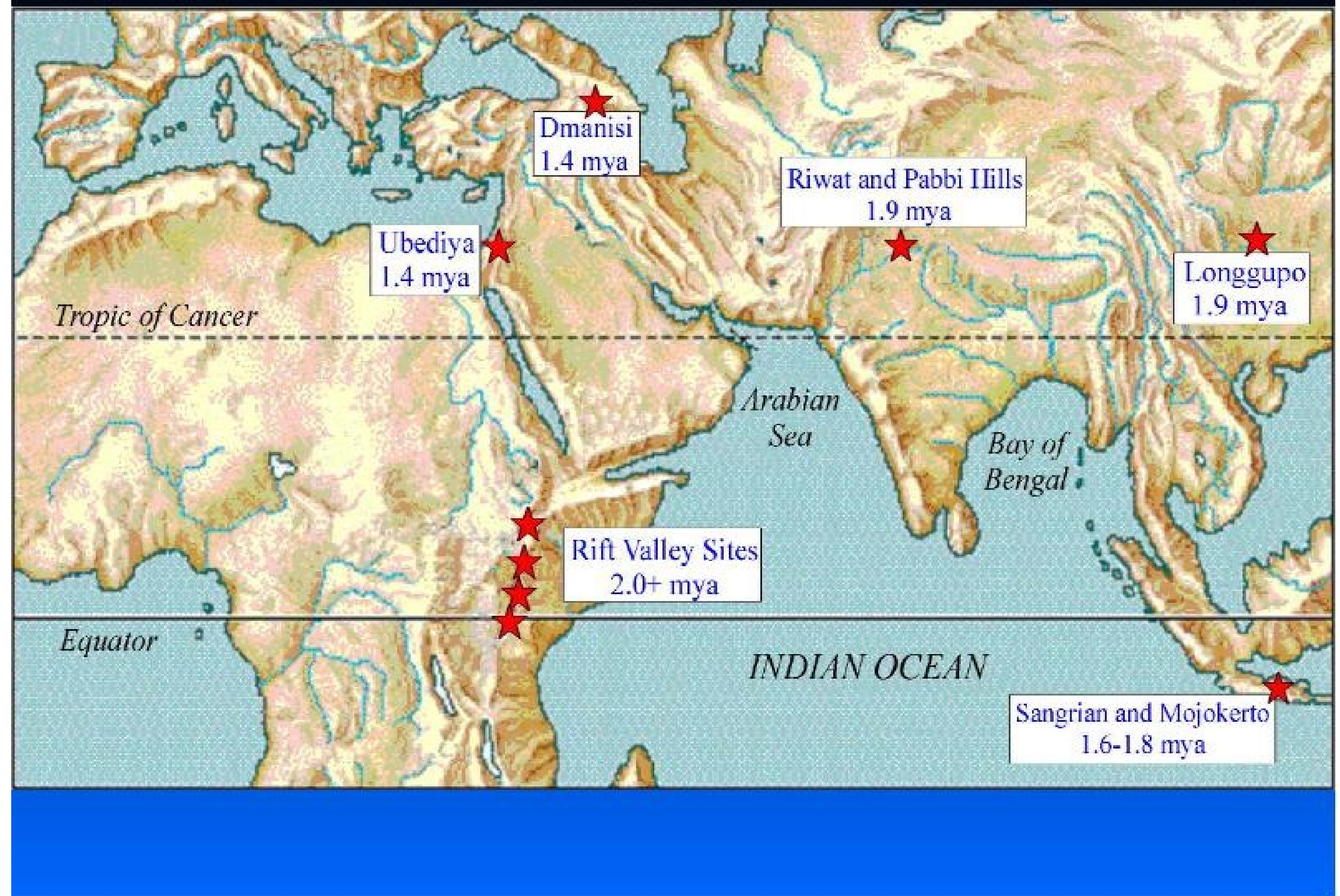
There is no doubt that the early humans, as represented by the genus *Homo*, originated in East Africa and it is from there that they expanded into the rest of the African continent as well as to Eurasia and Australia. The controversies arise when we start discussing the question of when, why, and how. A lot of research has gone into the attempts to answer these questions and a lot has been written on this topic during the last several decades. Susan Anton and Carl Swisher (*1*) have reviewed this research in an excellent article from which we extract the followings. This is somewhat technical, paleoanthropological, rather than historical material but is reproduced here to furnish a foundation for the discussion to be followed in the subsequent pages.

Until a decade or two ago, most evidence suggested that hominins had been restricted to Africa until about 800,000 years ago (2,3,4) and the earliest accepted East Asian hominin sites were between 500,000 and 800,000 years ago (2). 'Ubeidiya, Israel, represented the best evidence of 1 million years but was widely attributed to, at best, short-term hominin forays outside Africa (3,5). Thus, the earliest hominin dispersal from Africa was considered by paleoanthropologists to be relatively late in human evolution. Hominins leaving Africa were thought to leave Africa only with Acheulean technology. Such a view has been dubbed the "short chronology" (4). Given the presumed timing of this dispersal, paleoanthropologists often assumed the dispersing hominin to be a late form of Homo *erectus*.

This short chronology is contrasted with the opinion of many other workers in Asia who attributed the earliest hominin sites in Eurasia to much earlier times and a wealth of new data and sites have been offered supporting such a "longer chronology" of hominin presence outside of Africa (6-12). Although the precise age of many of these sites remains a controversial matter, the earliest occupation of Europe has increased to at least 800,000 years ago, of Western Asia to 1.7 million years ago, and of Indonesia to 1.6 or 1.8 million years ago. Perhaps the most important, and least contested, of these sites in regard to establishing an age for the earliest African dispersals are the discoveries at Dmanisi, Georgia, dated to approximately 1.7 million years ago; they are least contested both because of the combined radiometric, paleomagnetic, and biostratigraphic age estimates and because of the anatomy of the hominins discovered there. These discoveries get support from the discovery in 1980s the stone artifacts in northern Punjab, Pakistan, that have been dated to 2.1-1.9 million years ago in one case (Riwat) and 1.5-1.0 million years ago in another case (Pubbi Hills).

Given that the earliest finds for the presence of hominins outside Africa are relatively scarce, researchers have grappled with the nature of the evidence and its implications with respect to ‘long’ and ‘short’ chronologies (216,217). Some have argued that the earliest Plio-Pleistocene dispersals into Eurasia indicate relatively continuous occupation as part of multiple dispersal events (1,218) while others contend that early dispersals were temporally and spatially discontinuous, implying short-term success after colonizations (217). Robin Dennell, has been a strong voice in this debate; according to him hominins were present in Asia much before 2.0 million years ago and that Homo *erectus* may even have an Asian origin (14). His arguments have already been discussed in Chapter II.3. and some of them will be referred to here.

Although scholars may quibble as to whether hominin dispersals from Africa began at 1.6 million years ago or as early as 1.8 million years ago or even 2.0 million years ago, all data point to hominin dispersal substantially prior to 800,000 years ago years ago, a date conventionally agreed upon just a few decades ago. The newer data correlate the first dispersal with the appearance of hominins typically referred to as *Homo erectus (sensu lato)* who carried with them an Oldowan tool technology. It appears now that after the later part of the early Pleistocene substantial areas of the Old World were no longer hominin-free.



Dispersal of hominids in Eurasia. Dispersal corridors opened out of Africa and across the Middle East into South and East Asia during the late Pleistocene. Corridors formed primarily along coastal land masses, the product of expanding polar ice caps and resulting drop in sea-level. Souther Arabia periodically connected with the East African Rift Valley, providing a landroute for human and other faunal dispersion.

Throughout this discussion we adopt the use of a Plio-Pleistocene boundary that relatively coincides with the upper Olduvai Subchron - Matuyama Chron (Normal to Reverse) geomagnetic polarity transition, calibrated at *ca.* 1.78 million years ago (see Section I). Therefore, the recognition of this boundary in the various regions becomes of utmost importance in the correlation and age assessment of these early hominins. Paleomagnetics, Ar^{40}/Ar^{39}, and Fission-Track dating, as well as faunal correlations, currently provide the best critical means of assessing age. Based on these methods, the mapbelow presents a general picture of hominin's presence at various sites.

Who left Africa? Homo *erectus* is generally believed to be the first hominins to leave Africa and this is what is taught in schools and colleges the world over. This conclusion has been drawn from work in Indonesia, indicating the earliest hominins there as *Homo erectus*. The very earliest Indonesian crania from the Sangiran (Pucangan) Formation are few in number and often badly deformed postmortem. The crania dating to between 0.9 and 1.5 million years ago are more numerous and less deformed and likewise exhibit morphology typical of Asian Homo *erectus*. The Dmanisi material is

particularly similar to African members of the species Homo *erectus* and particularly to those from Kenya, giving credence to the theory of Homo *erectus* to be the first hominins to exit Africa.

According to Dennell (14), however, the earliest emigrants of Africa could have been any species of early *Homo* or perhaps even an *australopithecine*. Specific assertions that an australopithecine may be present in the early assemblages cannot, however, be supported on the basis of current evidence. Given an earliest Pleistocene age for the first hominins outside Africa, some authors suggest that a less-derived hominin than Homo *erectus*, or a more primitive version of Homo *erectus*, may have been the first to disperse from Africa. The small cranial capacities (e.g.. <700 cc) of later discovery (D2700) at Dmanisi have raised the specter of a pre*erectus* dispersal (14), probably Homo *habilis*. and thus multiple taxa may be found in the early non-African hominin faunas (14,16,17,18).

Why did they Leave? It is believed that the geographic dispersal of *Homo* from Africa is intimately tied to the shifts in body size, changes in diet quality, and home range size. As these changed, so did change the foraging strategy, seeking new environment for foraging or expanding into similar environment to accommodate the newly expanding requirements. It is also likely that although the broad ecological parameters outlined above, including shifts in body size and foraging strategy, were partly behind these dispersals, other less logical or deliberate factors, such as curiosity, may have been involved as well. Certainly, if we look at the decisionmaking processes involved in modern human migrations we must also allow for any number of idiosyncratic causes leading to pre-modern human dispersal (19). The practical manifestations of these generalities are many and they have been abundantly discussed in paleoanthropological literature.

How many Dispersals? Over the past few decade increasing evidence has accumulated to suggest that hominins began dispersing from Africa in the early Pleistocene, a case we have summarized above. However, this evidence comes from only a few localities outside Africa. The tendency is to "connect the dots" between these localities with a single arrow and thus to imply that early dispersal was a single, unidirectional, always-successful event. From these few data points we try to sort out the types of hominin and non-hominin fauna, and toolkits that left Africa, as well as to discern the probable catalysts, if not the causes, of this dispersal. But this approach may lead us a bit astray and make the study confused and intractable.

Given modern mammalian dispersal and migration patterns it is likely that multiple dispersals of small groups of hominins occurred periodically, that the fossil hominins we currently know in the early Pleistocene outside of Africa come from slightly different source populations, that some of those that left stayed in localities whereas others moved further on, and that back migrations of organisms were possible (1). Probably, the various pulses of dispersal were controlled in part by cyclic Pleistocene climate, waxing and waning between glacial and interglacial periods. Although less affected in equatorial regions, certain corridors or migratory paths may have been differentially affected owing to more northern latitude or elevation. Given the lack of sufficient hard data, however, these scenarios can only be speculative, being derived from temporal correlations with global Pleistocene climatic patterns. Anton and Swisher discuss the possible underlying causes of such dispersal, including changes in body plan and inferred foraging strategy referred to above. Genetics has started to play a leading role in this discussion and researchers like Templeton (20) have marshaled such evidence for multiple dispersals out of Africa.

The Routes of Early Hominin Dispersal: Not much has been written about the routes of dispersal of

early hominins out of Africa. A southern route, across the Red Sea, has been talked about in generalities but no fossil or archaeological evidence has been offered. Petraglia (157), for example, has argued that hominids with Acheulian stone tools utilized the coastal route, hence it is possible that hominins may have been present in South Asia in early Pleistocene. This proposition seems to be rather far fetched as it involves the building of seaworthy crafts and a strong incentive to cross the big river, the Red Sea. On the other hand Korisettar, argues that archaelogical sites in peninsular India does not support the coastal migration for hominin expansion across the subcontinent and into Southeast Asia. Rather, Korisettar argues that hominins would have dispersed in terrestrial zones centering their settlement in river basins. How the early hominids might have reached the subcontinent, he is not clear. On the basis of his illustrative description (see map below), one assumes that he postulates the hominin expansion in the subcontinent through the coastal route up to the Indus Delta and then through the river valleys, particularly through the Indus plains in Pakistan and then along the Ganga-Jamuna basin, Naerbada Valley, and other river basins in India.

Robin Dennell (21) has dealt with this topic rather extensively. He proposes the so-called northern route, across the Sinai and through the vast grassy steppe, which he appropriately calls the “savannaland’. It is presumed that population growth around 2 million years ago may have spurred hominins to seek new foraging grounds and seek food that was crucial to their survival. A period of moist and favorable climate most likely expanded the range of such area, so these creatures may have simply followed their food source. This situation calls for a large inland migration of hominins who followed expanding grasslands and plentiful game to the Near East. Once these migrants from Africa had arrived in the Levant, the road into the heart of Eurasia was open. There was a continuous highway of steppe – not unlike African savannah in terms of its species composition – that stretched the East as the Thar Desert, across Sindh and Punjab in Pakistan. This view, although within the realm of possibilities, is not shared by many paleoanthropologists (5,22) although they themselves do not offer any better explanation. By the same token, the current data are insufficient to establish the full extent of hominid dispersal in the Asian grasslands at this time.

The greater Himalayan land mass was in place two million years ago and this is a formidable landscape. It could have captured the curious or the "lost," but may not have been attractive as a route

from west to east. So, the early humans probably would have gone around it, on the whole taking lines of least resistance to their movement. These would have included factors such as the availability of the kinds of food that these travelers ate, a need that may not have been exactly the same for all traveling parties, the availability of shelter (either natural or built) and, if Dennell (21) is correct, the availability of stone for the manufacture of tools.

Hominin Occupation of the Greater Indus Valley - Evidence from Pothwar: South Asia plays a pivotal role in

Korisettar’s model of terrestrial dispersal of hominins in peninsular India and furany discussion of Out-of-Africa **ther on to the Far East**

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Professor Robin Dennell

from the Gulf of Aqaba
to northern Iran, and
beyond into Central
Asia and Mongolia
(see fig. below). Mov

ing northward and
westward, some may
have entered the Bal
kans early on – the first

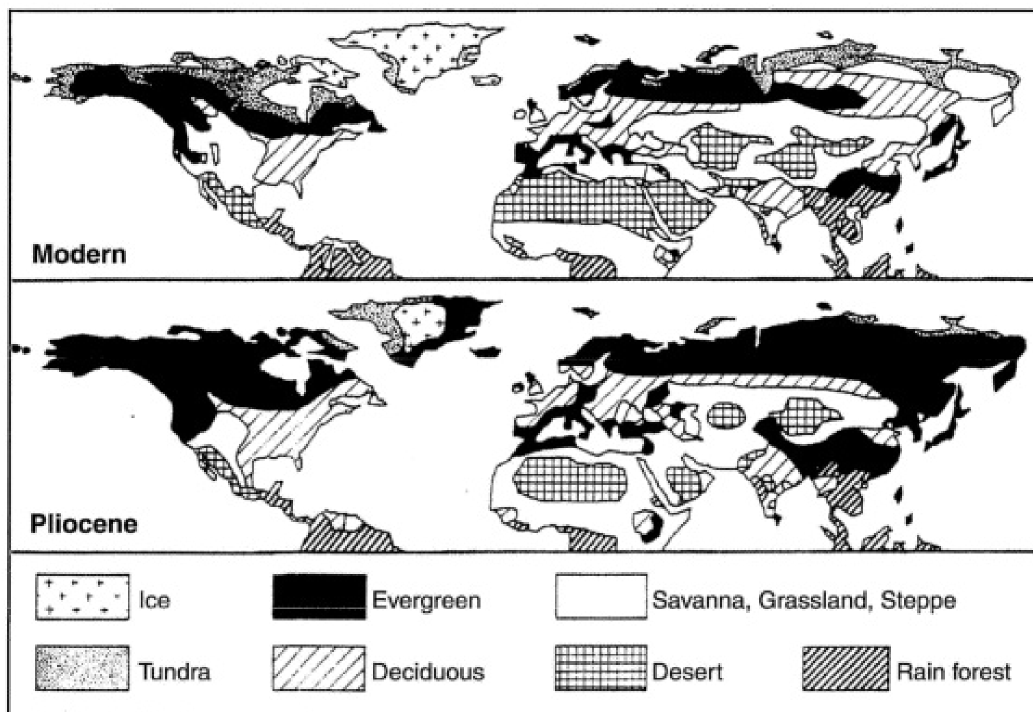


Fig. 1. Grasslands in the northern hemisphere now and in the late Pliocene, c. 3 mya. As indicated, grasslands were much more extensive than now between Africa and Asia, and there was no desert barrier between the two continents that might have impeded hominid dispersals. Early Pleistocene conditions were broadly similar to those of the late Pliocene. Source: Reprinted with permission from author (Dowsett et al. 1999).

2.47 mya at Luochuan (Lu et al. 1999), and in Central Asia at 2.5 mya (Dodonov and Baiguzina 1995). There was also a dramatic increase in the deposition of aeolian dust into the Sea of Japan c. 2.5 mya (Xiao and An 1999). In the Guanzhong and Yushe basins of central China, warm and dry conditions of the late Pliocene were replaced around this time by alternations of cold/dry conditions with a more xeric steppe vegetation, and shorter episodes of warm/wet climate with forest and grasslands (Han et al. 1997; Shi et al. 1993). These Asian changes all indicate a strengthening of the winter monsoon in East Asia, and the intensification of high pressure systems over Siberia.

The paleoenvironmental record for the early Pleistocene of southern Asia south of latitude 35° N is patchy, but the general picture is that the Pliocene grasslands of 3 mya were still largely in place in Southwest and South Asia, and that conditions were moister than at present. These areas are discussed in detail below.

Northeast Africa and the Levant

Extensive, moisture-induced landslides across much of the northern Sahara testify to considerably moister conditions in the late Pliocene (Busche 2001). In the northeast Sahara, the Plio-Pleistocene boundary was characterized by a relatively moist climate supporting the growth of conifers and the formation of carbonate sediments. For much of the Plio-Pleistocene, the main part of the Nile draining

" "
(ZJ, , . Ice _Evergreen + • •

C]savanna, Grassland, Steppe
Boesert _ Rain forest
Grasslands in the northern hemisphere now and in the late Pliocene, c. 3 mya. As indicated, Fig. 1. Grasslands in the northern hemisphere now and in the late Pliocene, c. 3 mya. As indicated,
humans in Europe. It is **grasslands were much more extensive than now between Africa and Asia, and there was no**
likely that this 'savanna
land' stretched as far to

grasslands were much more extensive than now between Africa and Asia, and there was no desert
desert barrier between the two continents that might have impeded hominid dispersals. Early
barrier between the two continents that might have impeded hominid dispersals. Early Pleistocene

Pleistocene conditions were broadly similar to those of the late Pliocene. (Dowsett et al. 1999**).**conditions were broadly similar to those of the late Pliocene. Source: Reprinted with permission
from author (Dowsett et al. 1999).
157
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lian dust into the Sea of Japan c. 2.5 my a (Xiao and An 1999). In the Guanzhong
Ancient Pakistan - An Archaeological History

dispersals given its central geographic position between western and eastern Asia and its low latitude position. If hominins reached East Asia by 1.8 million years ago, it has been hypothesized that South Asia

gesting that hominins dispersed outside their Afriof idiosyncratic causes leading to dispersal (19).
should contain artifact assemblages at least that oldcan ecological niche and thereby lost their
originalogy of hominin presence outside Africa beginning at
The practical manifestations of these generalities

(175, 206). Such a dispersal event presumes moveabout 1.6-1.8 million years ago. Collectively, these ment of hominins from South Asia to East Asia, fol is generallydata indicate an early Pleistocene date for the initial lowing a southern or low latitude route. Although suchbelieved to be the first hominins to leave Africa and **How many Dispersals?** The title of this secdispersal(s) from Africa of a hominin carrying a core

it is taught in schools and colleges the world over tion implies multiple early dispersals. Over the past a hypothesis is plausible, the evidence to support and flake tool technology, resembling Olduvan. The such a dispersal is not clear.
(see Section II). However, according to Dennell decade increasing evidence has accumulated to
More specifically, if the cranial anatomy of these hominins indicates that(14), they could have been any species of early suggest that hominins began dispersing from Africa

long chronology for hominin occupations of Eurasia these hominids belonged to early African Homo *Homo* or perhaps even an australopithecine. Given in the early Pleistocene, a case we have summa is correct, there should be an expectation that Modean earliest Pleistocene age for the first hominins *erectus*. Although the resolution of the fossil record

I assemblages of Late Pliocene or Early Pleistocene
outside Africa, some authors suggest that a less
only a few localities outside Africa. The tendency is
of the early ex-African sites could be interpreted as

derived hominin than Homo *erectus*, or a more to "connect the dots" between these localities with a age (Oldovan type stone tools) would be recovered may have been a single wave of dispersal, the anatomy of the primitive version of Homo *erectus*, single arrow and thus to imply that early dispersal in the region. Indeed, one might expect that the hominin fossils outside of Africa and dispersing patalways-successfulPlio-Pleistocene environments of peninsular India

the first to disperse from Africa, and thus multiple was a single, unidirectional, taxa may be found in the early non-African hominin
terns of extant animals are suggestive of several
event. From these few data points we try to sort out
would be particularly attractive, with their high biofaunas (14,16,17,18). Specific assertions that
ansource populations of Homo *erectus* migrating at mass in grass-land and savanna settings
(175,australopithecine may be present in the early asslightly different times. Increasing body size and
200). Such an evidence in peninsularsemblages cannot be supported on the basis of probable catalysts, if not the causes, of this disper
current evidence.
India is, however,
meagre to nonexistMostpreviouswork
ent. All available chronometric dates so
concludes that the earliest

far achieved indicate younger ages or hominins in Indonesia are the Acheulean, dated to 700–400,000very

in
Pakistan
and
earliestlessIndonesian 350–crania
to than
from the Sangiran (Pucan
250,000 in India. This later age range
would
incorporate
gan) Formation are few in
number
and
many Achuelean often badly

assemblages that contain well-made
deformed postmortem. The
bifacial implements and cores showingbetween preparatory techniques.0.9 and 1.5 million years The ago are more numerous

Pothwar less region, in the and deformed and north of the Punjab plains in Pakistan,

likewise exhibit morphology
is, however, an exception. In this con
typical of Asian Homo *erec*

nection the site of Riwat and the artifacts recoved from here are important as they The Dmanisi material

represents
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of the
best
is particularly similar to Afripotential
cases
for
a
Late
can members of the species Homo
Pliocene
presence
erectus and par
of hominins in the subcontinent. The
ticularly to those from
Olduvai Subchron, ca. 1.7–2.2 million years ago (205).
Summary: In the past two decade, a wealth of new data has supported a longer chronol
General outline of key events in hominin evolution in South Asia
Estimated Age Geological Timeframe Key Localities
0.9 million years ago Middle Pleisto

cene
Dina & Jalalpur (Pakistan) Hungsi-Baichbal (India)

0.9 - 1.8 million years ago
Early Pleistocene Pabbi Hills (Pakistan) Isampur Quarry ? (India)
1.8 - 2.5 million years ago
Pliocene Pabbi Hills (Pakistan) Riwat (Pakistan)
Riwat locality has yielded a small numKenya, giving credence to
ber of flaked pieces dating to
the theory of Homo
ca.
1.9 million years ago

to be the first hominins
sal. But this approach may lead us a bit astray. Given modern mammalian dispersal and mi
home range size are likely responses to changing
to exit Africa. However, the small cranial capacities ecological conditions at the evolution ofgration patterns it is likely that multiple dispersals of *erectus* and or more (175,201,202). Two pieces that are consid
(e.g.. <700 cc) of later discovery (D2700) againare perhaps part of a web of "eco-morphological" ered to be definitive cultural objects were obtained dispersal (14).factors that fueled the rapid expansion of Homofrom a conglomerate formation. Other pieces, thoughtraised the specter of a pre*erectus*

Why did they Leave?

It is believed that the
Pleistocene outside of Africa come from slightly dif
erectus from Africa into Asia in the early Pleistoto be cultural objects, were found in an associated from Africa is intiferent source populations, that some of those thathorizon. Great effort has been put on establishing themately tied to the shifts in body size, changes in dietcene, around 1.8 million years ago. Some scholars,
left stayed in localities whereas others moved fur
quality, and home range size. As these changed,like Robin Dennell, go even further: they place thecontexts of the finds and the cultural nature of thether on, and that back migrations of genes or organso did change the foraging strategy, seeking newearly hominins in Asia more than 2 million years
isms were possible (1). Probably, the various pulses
flaked pieces but the discovery still remains controago.versial. environment for foraging or expanding into similar environment to accommodate the new expanding In a second important locality in the UpperIt is also likely that althoughthe requirements. in the subcontinent are probably dispersed withoutSiwaliks, archeological investigations in the Pabbibroad ecological parameters outlined above, includequatorial regions, certain corridors or migratory Hills
have yielded stone artifacts on erosional sur
ing shifts in body size and foraging strategy, were
trace or buried deeply, or have not been found yet. paths may have been differentially affected owing to
faces of fossilierous deposits (203). Overall, 607
partly behind these dispersals, other less logical or The Riwat finds in Pakistan contain genuine arti
more northern latitude or elevation. Given the lack
pieces of deliberate factors, such as curiosity, may have beenfacts, but their provenience and dating (1.9 millionflaked stone were found that were con
involved as well. Certainly, if we look at theyears ago) are subject to debate. The earliest claim sidered artifacts. These consisted of simple cores decision-making processes involved in modern hutions with global Pleistocene climatic patterns. Geand flakes and were found in 211 locales, mostly
man migrations we must also allow for any number
for Acheulean occupation in India is at the Isampur
netics has started to play a leading role in this dis

consisting of isolated items where no more than
three objects were found at a single place (204).
Approximately half (n = 307) of the stone pieces
were found dating to 1.4–1.2 million years ago; 102
were found on exposures dating to 0.9–1.2 million
years ago; and 198 pieces on exposures of depos
its that belonged to, or that were earlier than, the

Quarry; its dating (1.2 million years ago) is, how

ever, equally debatable. The earliest secure radiometric dates (Ar^{39}/Ar^{40}) are from Bori localities, near Pune, with 650,000 years ago for the Acheulian while isolated stratified finds of flakes may go back (if confirmed) to 1.4 million years ago, hence as early as 'Ubediya'. Equally ancient may be the artifacts collected from the Pabbi Hills (1.0 to 1.4 mil

of dispersal were controlled in part by cyclic Pleisto
cene climate, waxing and waning between glacial
The earliest remains of human occupation
and interglacial periods. Although less affected in
lion years) and still older artifacts from Riwat (1.9-2.1 years) in Pakistan.
DISPERSAL OF MODERN HUMANS IN EURASIA

Questions about the origins of Homo *sapiens* and their spread around the world fascinate scholars as well as the general public. It is an interesting subject but at the same time quite involved. Like the spread of early hominins, it is shrouded in mystery and a lot of controversy (19,23,24). These controversies abound almost at every step as the length of this chapter would reflect. Central questions to the study of human evolution are when and where modern humans first evolved, and how they colonized areas outside their place of origin.

As indicated in the introduction of this section, human dispersal is inextricably connected with origins of man. The basic question is: did the modern human evolved in Africa and from there he dispersed in Eurasia, displacing all pre-modern forms in his wake, or did he evolve through a prolonged interbreeding process within the preexisting regional forms with their neighbors as one single species, as they expanded their range? In other words, do we believe in Recent Out-of-Africa model for the emergence of modern humans or in Multiregional model to explain his origin and dispersal?

If we subscribe to the Out-of-Africa model, as we do in this chapter, we are forced to contemplate the routes, which these modern humans may have followed in the process of dispersal from their source of origin in Africa to Eurasaia. Additionally, there is the perennial question of timings: When did modern humans began to disperse in Eurasia and what were their times of arrival in different parts of the world. Paleoanthropology offers us some temporal points to consider but they are few in number and rather disjointed in spatial context. Archeogenetics seem to be somewhat more precise (although not necessarily more correct) and this discipline makes the question of timing appear at every turn of the discussion. In fact, the debate on the origins and spread of modern humans has recently become largely a domain of population genetics and its role in the discussion of human colonization of the Old World has become seemingly more important than that of archaeology and anthropology. For its increasing importance and for the tediousness of the subject matter, therefore, we devote a considerable space to this topic in this chapter as well as the ones that follow.

Compared to the dispersal of hominins, discussed in the above, the examination of the dispersal of modern humans could have been easier for the closeness of this event to the present, but here the controversies surrounding the Neaderthals have hijacked the entire debate. Moreover, the concept of the modern man being a unique species borne in Africa and from there spreading all over the globe, replacing all other human species which may be present, or, alternatively, the modern man being borne through the interbreeding of the 'locals' with the 'newcomers', has put the discussion of the subject on a different level. Thus, it is not easy to concentrate on the dispersal of early humans and

colonization of continents without engaging in the discussion on the origins of man.

Although the question of the origins and dispersal of modern humans is as complex as that of their ancestor hominins (19,23,24), here we have some more tangible information, and archaeological data form a somewhat firmer basis for our speculations. We also have an increasingly large bank of genetic data that can be used to trace the journey of modern humans. Still, just like our musing about the migrations and dispersal of our ancestors before the appearance of modern man, we are faced with some equally fundamental questions that need to be answered. The most basic question is about the origins of modern man, that is, before we even start to discuss the dispersal of modern humans over the globe, we must settle the question: Where did indeed modern man originate and when? The peopling of any particular region, such as South Asia or Pakistan itself, is, of course, integrally connected with this broader issue.

A Starting Point - The Conventional View: The question of the origins of man has been amply discussed in Chapter II.4. It is clear from there that the discussion related to the dispersal of modern humans over all continents essentially pertains to the means by which earlier humans of archaic anatomy gave way, in the past 200,000 years or so ago, to people of essentially modern anatomy who are classed as Homo *sapiens*. While the evidence exclusively supports neither theory, the current debate has generally focused on two basic models, along with their variations, for this process *Recent African Origin* and *Multiregional Evolution*. If we believe in the first option, namely Recent African Origin, we tend to gravitate toward the scenario of human dispersal through physical migration and colonization, replacing all previous species which may have existed in the respective regions. Genetic trees and coalescence dates take the central place in the discussion. But, if we put our faith more in the second option, namely, the Multiregional or Continuity model, we mostly talk about the spread of modern human *traits* in the preexisting populations (Homo *erectus*, archaic Homo sapiens, etc) through genetic imperatives. Here paleoanthropology and archaeology primarily lead our way.

These are two vividly contrasting pictures but we need to settle on some model of the appearance of modern man and evoke some hypothesis of the place and time of his origins before we can proceed any further. In this chapter, we shall deal with the subject from the point of view of the conventional wisdom on human origins and dispersal. It is based on the Recent-Out-of-Africa model (49,50) and depends on the construction of lineages, genealogical trees, and their various possible And, of course, there is the perennial question of why? Although not central to the issue, the question has been asked: Why human population dispersed from Africa? What were the specific conditions that stimulated this process? We do not have any satisfactory answer to this question. Climate change, population expansion, increased alliance network, projectile technology, and the emergence of complex behavior associated with the use of language and symbolism have frequently been called upon to answer this question but researchers remain divided in testing the contribution of each variable. Some of these traits lack concrete archaeological traces (e.g., language), while others (lithic technology and symbolic relics) are inconsistently represented across regions.

The fact that dispersal is not a unique phenomenon to humans makes it difficult to identify a single cause or to establish a universal model for early modern human dispersals. For instance, paleontological studies show that numerous terrestrial mammals (e.g., several carnivores, the straighttusked elephant, hippo, and some primates) have dispersed from Africa to Eurasia in the PlioPleistocene span. In essence, if dispersal is a response shared by other organisms, it is likely the case that the forces that stimulated dispersals in other species may have triggered early modern

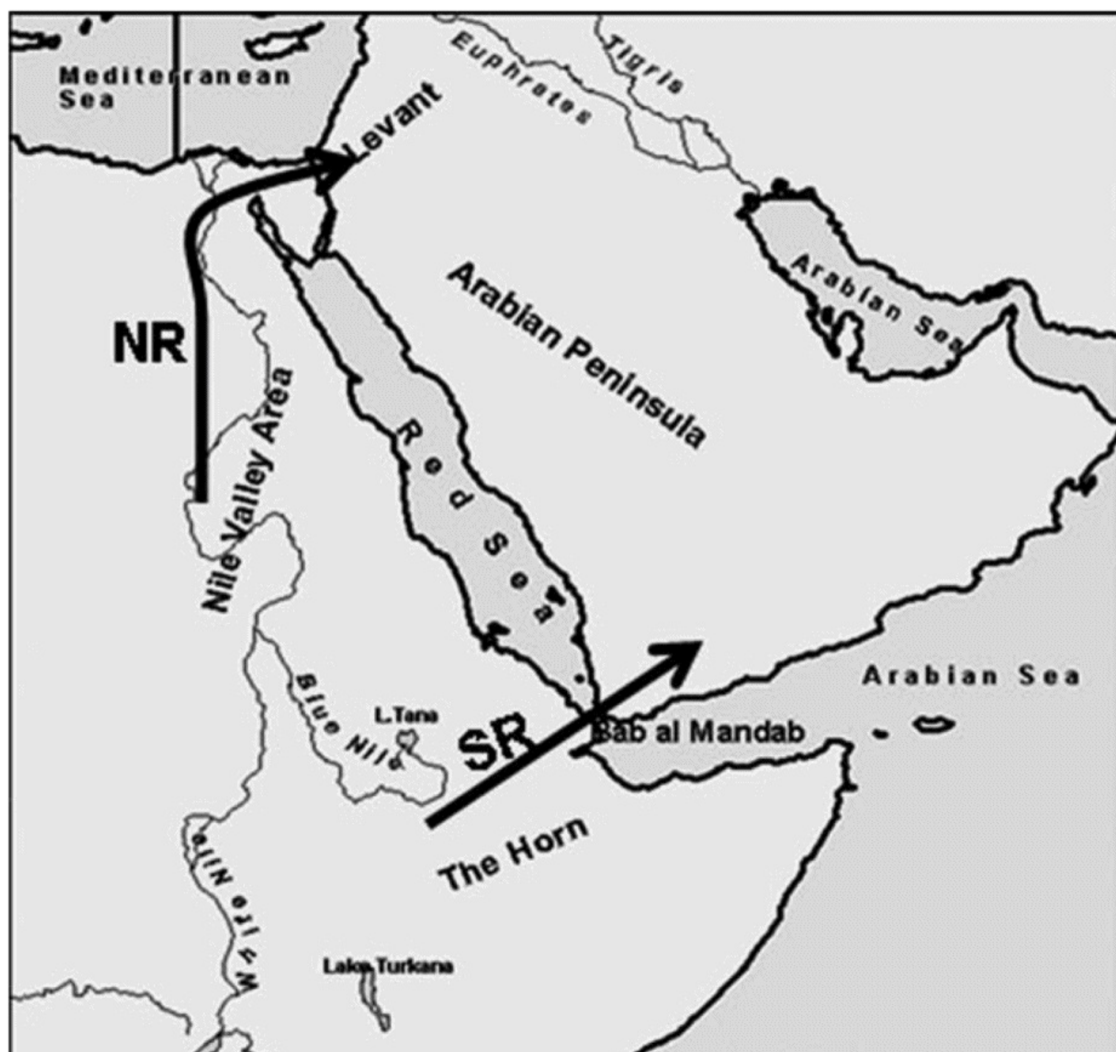
human migrations out of Africa also.
branches. The overall concept is based on the hypothesis that this human journey took the form of a physical migration and expansion of human population over many, many generations, leaving genetic "signatures" in descendant groups and that these signatures can be read through the analysis of genetic markers of present populations in the region We shall deal with the subject from the perspective of Multiregional Evolution in the next chapter.

As discussed in Chapter II.4, the commonly held view of proponents of Recent African Origin is that there was a speciation event in Africa around 150,000-200,000 years ago that resulted in the emergence of anatomically modern humans. This was followed, it is proposed, by a migration of a small band of modern humans out of Africa and the subsequent replacement of all archaic people without any interbreeding with them. Some variations of "Out-of-Africa" theory, for example that of Bauer (51) and Smith (146), suggest an African emergence of modern humans but with the provision of *some* admixture with the archaic residents in other continents.

There is no need to repeat the arguments that are offered for the Out-of-Africa or Replacement hypothesis. Briefly speaking, so far the oldest cultural traces and fossil remains of anatomically modern human have been discovered in East Africa, specifically in Ethiopia (41,42,43). This, naturally indicates East Africa as his birthplace. Modern mitochondrial DNA data (25-34) reinforce this paleoanthropological evidence (44,45,46). Also, African populations display greater genetic diversity, implying that Africa was populated by modern hu
mans and their ancestors longer than any other re
gion (10,19). From this, archaeogeneticists hy
pothesize that all modern human genes descended
from a single population - dubbed “African Eve”-
from a single population - dubbed “African Eve”-

200,000 years ago. These genes then dispersed
throughout Africa and Eurasia, forming the modern
human race as a sole surviving species of man. The
lingering issue is how soon they formed effective
founder populations outside of Africa and how they
dispersed after their exodus from Africa.

The mere acceptance of the African origin
for modern humans does not settle the issue of dis



persal; there are the question of route or routes that early modern humans took out of Africa and there is the question of timing. At the center of the discus sion lies the question of whether eastern Africa alone was the source of human dispersals into Eurasia or were there other loci of human expan sions within Africa from where they dispersed in Eurasia? This question is being discussed under the ambit of Single or Multiple Centers of Human Dispersals**.** The question of whether modern hu mans left Africa in a single dispersal event or in mul tiple episodes needs to be answered too. Northeast Africa, Southwest Asia (the Levant), and the Ara bian Peninsula have been major foci of research on this topic.

Two alternative and plausible points of crossing of the modern man from Africa into Eurasia

Routes of African Exodus: Researchers have proposed several different routes for the dispersal of Homo *sapiens* (36,52-58) but ultimately two dispersal routes have become widely accepted for early modern humans out of Africa (25,35,36,54,59,60). These are the Northern Route (NR) via the Nile-

Sinai Land Bridge and the Southern Route (SR) through the Strait of Bab al Mandab at the southern end of the Red Sea (see figure below). The Levant and the Arabian Peninsula play a central role in the current debate due to their strategic location at the main gateways of biogeographic connection between Africa and Eurasia. Both regions have yielded rich Paleolithic and paleontological data that are useful in any discussion of prehistoric migrations of homo *sapiens* out of Africa and vice versa. What follows below is a brief discussion of these two proposed and widely accepted routes in context of the Upper Pleistocene.

Southern Route: Eastward Dispersal from northeast Africa to Arabia: The Bab-al-Mandab Strait at the southeastern end of the Red Sea has been frequently proposed as a possible exodus route for early modern humans out of Africa. This route proposes that Upper Pleistocene foragers specifically adapted to coastal habitats in northeast Africa dispersed into Southern Arabia via the Strait of Bab al Mandab during low sea level events associated with major glacial episodes (25,28,29,35,36,61). According to this theory, during such climatic events the Arabian peninsula made land contact with coastal east Africa, and this provided an ample opportunity for some groups of Homo *sapiens* to cross-over into South Arabia. Once they entered southern Arabia, those human groups may have dispersed eastward using a coastal route along the Yemen-Oman littorals up to the Persian Gulf and South Asia, or they might have traveled northward up to the Levant and from there into the Middle Asia and the Indian sub-continent.

Most advocates of this route link it with the initial colonization of East Asia and Australia. This route is mainly supported by genetic data (11, 62, 63). There are some technotypological similarities between Paleolithic sites in northeast Africa and the Arabian Peninsula indicating sporadic Upper Pleistocene cultural contacts (5,64,65). Generally, however, the role of the Southern Route to long-term human occupation of Arabia and Southeast Asia remains unclear due to the lack of fossils and secure dating for the artifactual sites. While recent field investigations in the Arabian Peninsula have pointed to a possible link between northeast African and Arabian Middle Pleistocene archaeological complexes, the question of their cultural connection to the Horn of Africa remains unresolved owing to a lack of detailed information from the African side of the Red Sea coast.

Of course, getting into Arabia in the first place says little about routes between northeast Africa and the Eurasian landmass. Whether coastal movements beyond Arabia into South Asia and the Indian subcontinent itself through a coastal route were possible is a much larger question and one that has been discussed by a large number of researchers, most recently by Petraglia et al (76). They have argued that populations expanded along the Indian Ocean rim at *ca* 60,000 years ago during a single rapid dispersal event, probably employing a coastal route towards Australasia. Archaeologists have been relatively silent about the movement and expansion of human populations in terrestrial environments along the Indian Ocean rim, although it is clear that Homo *sapiens* reached Australia by ca 45,000 years ago. They suggested that modern humans were present in Arabia and South Asia earlier than currently believed, and probably coincident with the presence of Homo sapiens in the Levant between ca 130 and 70 000 years ago. In this connection the recent discoveries at Jebel Faya in UAE (30) are very significant (see Chapter II.3). They showed that climatic and environmental fluctuations during the Late Pleistocene would have had significant demographic effects on Arabian and South Asian populations, though indigenous populations would have responded in different ways.

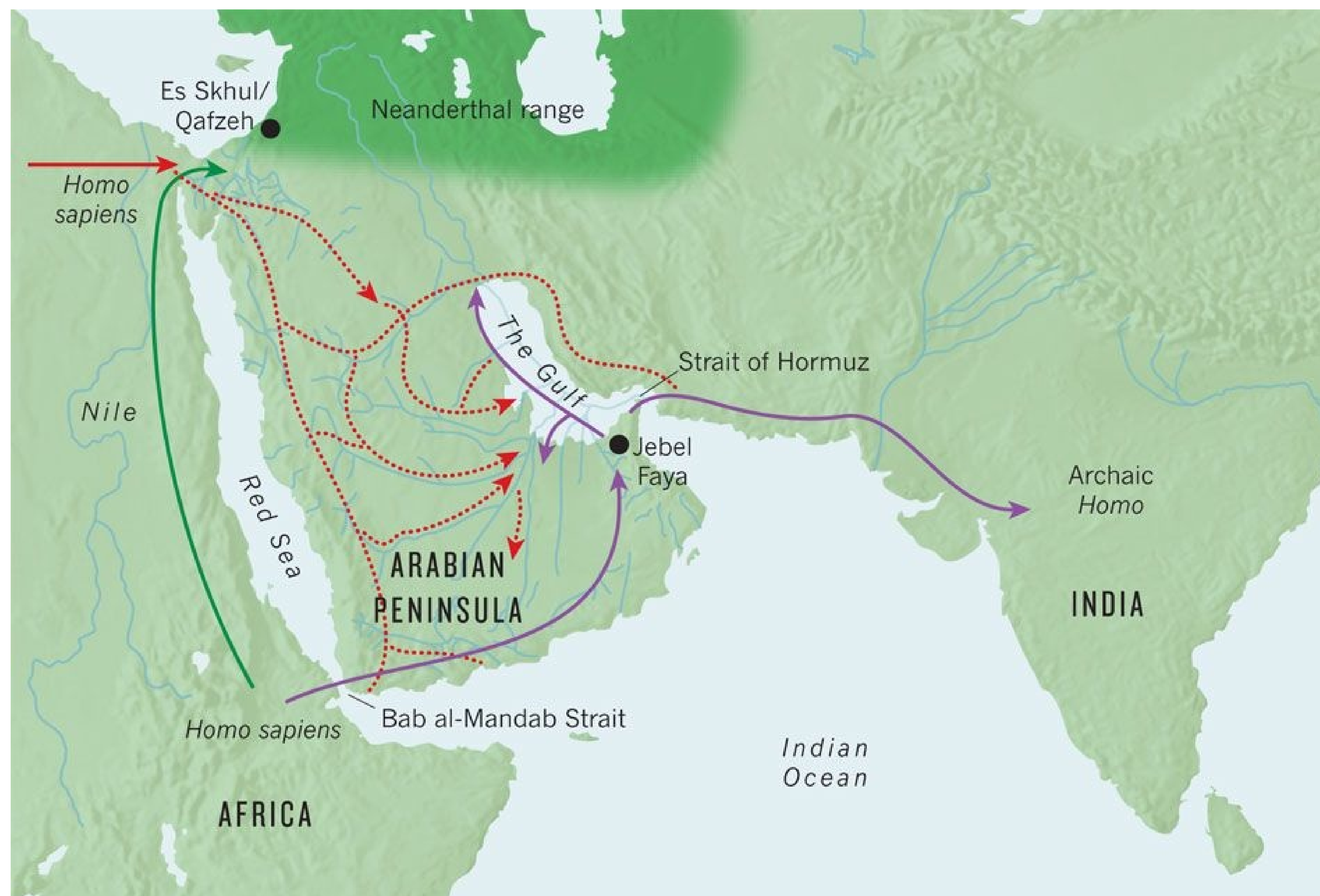
We have the impression, from general considerations of present-day topography, that while movement around the coast of India may have been reasonably attractive, the possibilities for

population expansion along the Makran coast of southern Iran and Pakistan may have been rather more limited. Conversely, GIS modeling, to be discussed later, makes the Persian Gulf and Makran coast a favorable area of human migration.

The Northern Route: Another possible route for African exodus is the so-called Northern route. Advocates of this route propose successive dispersals of hominids and early modern humans from northeast Africa into the East Mediterranean Levant via the Nile-Sinai Corridor (6, 54, 56,70). Before the recent discovery at Jebe Faya in UAE (30), the modern looking fossil remains associated with Middle Paleolithic industries at the Levantine cave sites of Jebel Qafzeh and Skhul, dating in the range of 130,000-90,000 years ago (77,78,79), were considered to be the first dispersal of early modern humans from Africa (25). As such, this event has been variously described as an “early dispersal of anatomically modern humans” by Finlayson (80) or “temporary dispersal of anatomically modern populations” by Mellars (27).

The identity and evolutionary significance of the Qafzeh/Skhul populations remain not well understood (79). It is unclear whether they represent dispersed African hominins or *in situ* evolution from pre-existing Levantine archaic forms. Another intriguing question is what role did the Qafzeh/Skhul populations play in the Upper Pleistocene colonization of Eurasia? Perhaps, some lineages of this group specifically adapted to the Levantine environments may have served as source populations for later expansions to Europe and South and East Asia. Alternatively, the Qafzeh/Skhul hominins may have migrated to Arabia (81,82) or to North African coastal refugia (61) in response to overpopulation or climate changes associated with MIS-4, a glacial episode dating between 75,000 and 60,000 years ago (83). These early explorers probably never made it beyond the Levant, but many archaeologists have suggested that a later wave of humans followed a similar route.

After the Qafzeh and Skhul groups, no modern human presence has been detected in the Levant until after 50,000 years ago (84). By this time, humans had already reached Australia (85,86).This long gap in the fossil record for modern human reappearance in the Levant may imply an interruption of the East African-Levantine connection. One possible explanation for this is that the extreme cooling of the North Atlantic during MIS-4 glacial episode may have caused the Intertropical Convergence Zone and its rainfall belt to move southward closer to the Equator. In this regard, Carto et al. (87) note that “the more open and arid landscape in the Sahel region may have acted as a major barrier to early *H. sapiens* dispersal at this time, restricting movement into North Africa.”



Armitage *et al*. (Armitage, S. J. *et al*. 2011, *Science* 331, 453–456) propose a southern route for the migration of modern humans from Africa into Arabia and beyond (purple arrows). They argue that modern humans left Africa by crossing the Bab alMandab Strait, and moved along the southern margin of Arabia to reach Jebel Faya 125,000 years ago. During dry periods, the population would have moved eastwards, along river routes that are now submerged in the Gulf. The Jebel Faya population could have eventually reached India, where they might have interacted with extant archaic *Homo* (Petraglia, M. D. *et al*. 2010, *Ann. Hum. Biol*. 37, 288–311)Alternatively, humans may have entered Arabia from East Africa (green arrow) or from the Sahara (red arrow), eventually reaching the Es Skhul and Qafzeh caves in Israel, where human fossils have been found. During wet periods, Arabia had a network of rivers and lakes that would have then facilitated human dispersal across the peninsula in southward and eastward movements (broken red arrows). Interbreeding may have occurred with Neanderthals who lived to the north of the Arabian peninsula.

Last Interglacial (specifically in the time range of 130,000-117,000 years ago). On the basis of this evidence and the discovery of some discrete lithic traditions in the region (specifically Algerian sites), the authors propose that the central Sahara/Libyan Desert may have served as an alternative dispersal route for early humans from central and NE Africa into the Mediterranean coast. Populations that took the central Saharan route may have ultimately dispersed to Southwest Asia along the Mediterranean coast. Perhaps, the Qafzeh and Skhul remains may represent an off-shoot of this dispersal route.

Single or Multiple Migrations: Granted that Homo sapiens first emerged in Africa, the question

Outside of the Nile Corridor, two additional dispersal corridors from East Africa into the Levant seem to have been present in the Upper Pleistocene: one to the west through central Sahara to North Africa (205) and the other to the east along the western coastal margins of the Red Sea basin (33,35), as depicted in the figure below. Using geochemical data from wadis and by locating several fossil river channels in the Libyan Dessert, Osborne et al. (209) recently demonstrated that human corridors existed through the central Sahara during the of whether they left Africa in a single dispersal event or in multiple episodes has never been resolved. Within the Outof-Africa theory, there are three principal models for human dispersals out of Africa (as reviewed by Ambrose (82). The first one, commonly referred to as the “Strong Garden of Eden”, or the “African Eve”, model posits that after modern humans first emerged in Africa between 200–150,000 years ago, they dispersed to other parts of the world after 100,000 years ago and replaced all archaic hominins without any genetic admixture. The second model known as “Weak Garden of Eden” asserts that anatomically modern humans evolved in a restricted area of Africa sometime after 200,000 years ago and dispersed to separate regions around 100,000 years ago replacing all archaic forms. According to the latter model, each human population is thought to have passed through a bottleneck in their respective destinations and then recovered after favorable conditions returned. Advocates of this model claim that around 50,000 years ago,

Later Stone Age/Upper Paleolithic (UP) cultural innovations triggered population expansion within isolated groups in Africa and Eurasia. The third dispersal model associated with the Out-of-Africa origin theory argues for multiple dispersals of early modern humans out of Africa. Originally posited by Lahr and Foley (24), this hypothesis recognizes three dispersal events in the Upper Pleistocene, and perhaps a fourth one recently proposed by Armitage.

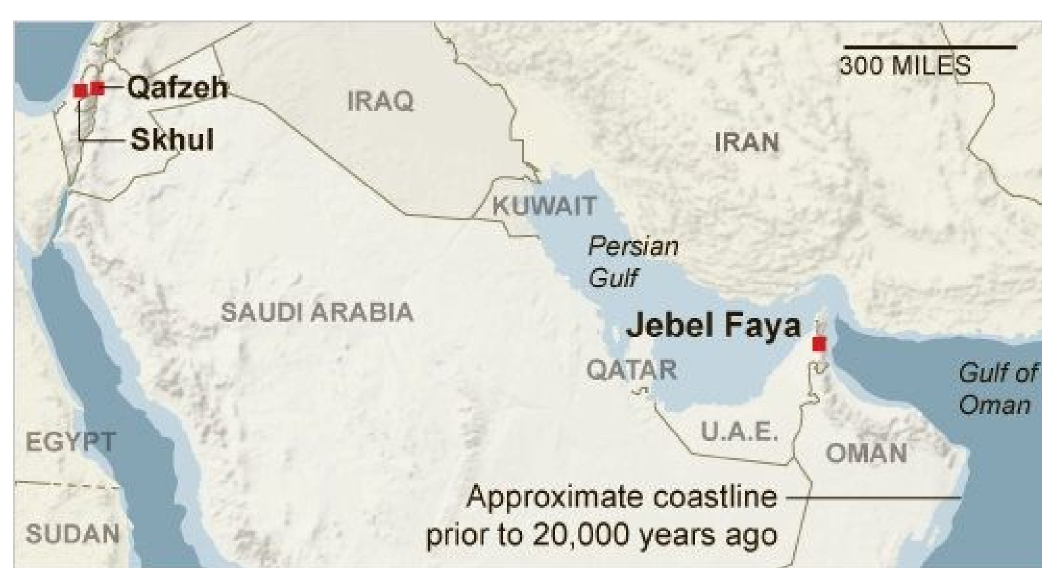
The view of two separate migrations – one through the Bab-el-Mandeb in the South and one through the Sinai into the Levant and Europe in the North - has seen a sudden resurgence in recent years as a large number of Eurocentric prehistorians and anthropologists have started to routinely refer to the crossing of modern humans into the Levant and then onward to Europe as though the history of the human colonization of Europe has no relevance to that of the rest of the Old World. This is perhaps the unwitting and unintended result of Templeton’s recent theory of multiple migrations (not multi-point migrations, noted below) out of Africa, which is not controversial.

Single or Multiple Centers of Human Dispersals? There is strong evidence, mainly genetic but also archaeological, that human migrations occurred multiple times from the same center of origins. However, since all this strongly implies multiple centers of human dispersal, it is an important point of dissension in the debate of human dispersal, and we need to look into it a little deeper.

The northern route of migration is typically associated with bladedominated, "Upper Paleolithic" or "Mode 4" technology, best represented at the sites of Boker Tachtit in southern Israel and Ksar Akil in Lebanon, both dated to around 45,000 to 50,000 years ago. The earlier migration route, the Southern Route, extended from the Horn of Africa across the mouth of the Red Sea (the Bab el Mandeb straits) carrying technologically simpler to "Middle Paleolithic" or "Mode 3" technology, which subsequently dispersed eastward along the coasts of southern and southeastern Asia all the way to Australia. The sharp contrasts in the technology associated with these two dispersals were taken as an explicit reflection of two separate source populations in Africa, representing two points in time.

The molecular genetic research, based on studies of both mitochondrial and Y-chromosome patterns in African and Asian populations (62,63,89,90,91), however, counters this conclusion. These studies suggest that the whole of modern Asian and European populations derive from one small subset lineage in Africa, which subsequently diverged into two derivative lineages, probably shortly after their dispersal from Africa. The crux of the arguments advanced by these researchers is that the very limited genetic diversity exhibited by modern European and Asian populations - compared to those in Africa - would be effectively impossible to reconcile with the model of two or more separate dispersal events, deriving from separate source populations in Africa and hypothetically at two or more different dates.

The Question of Timings: Initially posited by Kingdon (54) and advanced by Lahr and Foley (24) and lately by others (27,71,92,93), the human dispersal event is thought to occur around 60,000 years ago and be responsible for the colonization of South Asia and eventually Southeast Asia and Australia very shortly after. Dubbed “rapid dispersal,” or “coastal migration”, this event is typically associated with coastal and estuarine adaptations along the circum-Indian Ocean (27,54,94). The key assumption behind this hypothesis is that when northward movement from East Africa into the Levant was blocked due to the expansion of the Sahara Desert during MIS–4, some East African early human groups launched an eastward expansion via the Strait of Bab al Mandab (southern Red Sea) before they successfully dispersed to Europe and western Asia.



Map showing the location of Jebel Faya and the Arabian coastline during 185,000-125,000 years ago. Note the land connection between Jebel Faya region and coastal Iran, and the narrowing of the Red Sea.

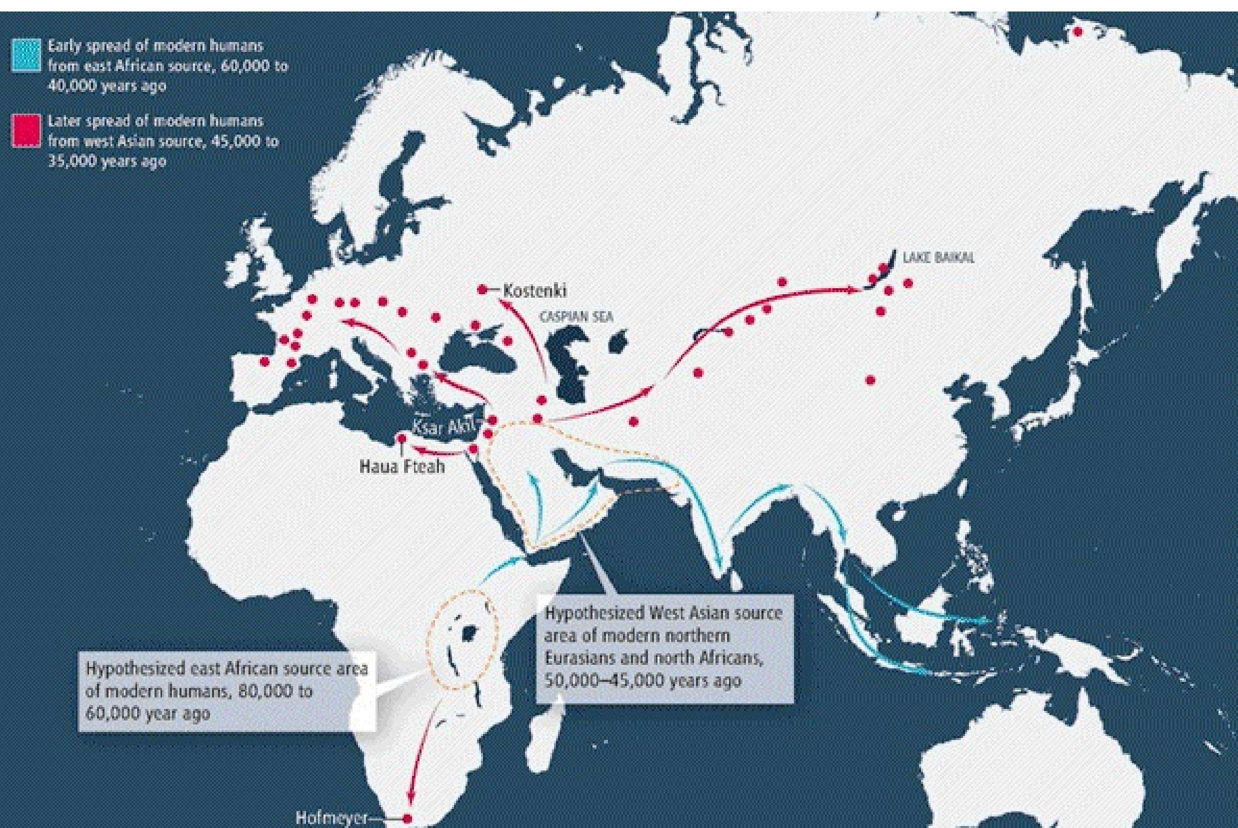
This rapid dispersal event is mainly supported by mtDNA analyses of some aboriginal populations in Southeast Asia and Australia. For instance, Macaulay et al. (34) identified mtDNA types M21 and M22 in their Malaysian sample, and Thangaraj et al. (93) discovered M31 mtDNA type among indigenous Andamanese tribes. All these subclades stem from haplogroup M, which is believed to have originated as a founder around 65,000 years ago. Haplogroup M is a direct descendant of the ancestral L3 haplogroup, which first appeared as a founder in Africa *ca.* 85,000 years ago (34). The short time gap between the coalescence date of L3 (around 85,000 years) and the arrival of its descendants in South Asia shortly afterwards (65,000 years) suggested to researchers that the initial colonization of South and East Asia involved rapid coastal dispersal of human groups from NE Africa via the Strait of Bab al Mandab and Arabo-Indian littorals (see pictorial depiction below).

According to Oppenheimer (95) and Macaulay et al. (34) the initial exodus into Arabia dates to roughly 85,000–70,000 years ago, resulting in the initial colonization of Australia at about 60,000 years ago, with a dispersal rate of 0.7 km/year. This is rather a short time span between these two distant points and consequently this a “rapid dispersal”.

There is, however, limited fossil and archaeological evidence supporting this event and on the basis of some new archaeological discoveries in the Persian Gulf, and recent discovery of modern human fossils in southern China, a number of archaeologists have begun to question these timings. In this respect, the recent discoveries at Jebel Faya in United Arab Emirates (UAE), dating to as old as 127,000 years ago is especially playing a crucial role in changing the hitherto generally believed chronology. More and more opinions are now tilting to a position that places the African Exodus during the terminal phase of Marine Isotope Stage 6 (MIS6), in the time range of 150–130,000 years ago. The observed lithic affinity between Jebel Faya and contemporaneous Middle Stone Age (MSA) assemblages in northeast Africa suggested to researchers that a direct route of migration may have existed between East Africa and Arabia during low sea level events associated with MIS-6, a glacial phase dating *ca.*180,000–125,000 years ago. The MIS-6 event is believed to have resulted in long-term human occupation of Arabia (or the tip of the Persian Gulf) from which later expansions to other parts of Eurasia may have commenced (74). The finds at Jebel Faya is the evidence.

A relevant evidence in connection to this timing is the recent discovery of modern human fossil remains in Southern China, at the cave site of Zhirendong (75). Dated to >100,000 years ago, the Zhirendong evidence signifies the presence of a successful Homo sapiens’ dispersal into Southeast Asia prior to 100,000 years ago, possibly through the Bab al Mandab during MIS-6.

An earlier argument for a chronology longer than 65,000 years has been an indirect evidence suggesting episodic cultural connections between Africa and Arabia. It comes from a study concerning hamadryas baboon phylogeographic history (66,68). The hamadryas baboon (*Papio hamadryas hamadryas*) is found exclusively in East Africa and western Arabia, and is the only free-ranging nonhuman primate in Arabia (68,69,). Previously, it has been hypothesized that hamadryas baboons colonized Arabia in the Holocene (70). However, a recent study of mtDNA variation among Saudi Arabian and East African (Eritrean) hamadryas populations showed that these baboons did not colonize Arabia in the recent past nor did they use a northerly route via the Sinai land bridge to enter Arabian Peninsula. The data suggest that hamadryas baboons reached Arabia via temporary land bridges formed during glacial maxima along the Strait of Bab al Mandab.



The spread of early humans from Africa to Eastern Asia is usually depicted by employing large, illustrative arrows like this through broad corridors traversing through the subcontinent but, surprisingly, few attempts are made to look for details.

Given the fact that the most recent common ancestor of hamadryas baboons lived in Arabia around 85,000-119,000 years ago, the likely time for hamadryas entrance to the Peninsula has been estimated *ca*. 86,000-220,000 years ago. If such a recent dispersal of hamadryas baboons was possible across the Red Sea (Strait of Bab al Mandab landbridge), this route must have been equally accessible to early modern humans during low sea level events in the Upper Pleistocene (197).

Although objections to the interpretations of Jebel Faya discovery are being raised, most archaeologists now subscribe to the crossing of Babel-Mandeb *ca.*125,000 years ago, rejecting the much entrenched earlier position which advocates that the ancestors of today's non-Africans left sometime around 65,000 years ago, quickly fanning out across Europe, Asia and even reaching Australia. That sequence of events doesn't leave much time for exploration, says one archaeologist, "The idea that they left Africa at 60,000 and ended up at Australia at 50,000 - my God, did they ever stop running!" he asks. But there are some who still persist on the old wisdom. According to these opinions the stone tools at Jebel Faya could have been produced by other archaic human relatives.

Genealogy of Human Dispersal : Archaeologists look at the stone artifacts of ancient humans on a worldwide scale and, through their comparative analyses try to decipher the routes they took to migrate and disperse. Anthropologists examine the fossils of these early humans and connect the dots to form a picture of their journey. Independent of archaeologists and anthropologists, geneticists try to do the same by looking into the molecular structure of the DNA of the present populations which are, after all, the end result of these early dispersals and population interactions.

Genetic data collected from populations all over the world, partly as a consequence of the Human Genome Project and partly the result of independent research projects, have started to shed some light on several theoretical issues of human evolution and dispersal. This genetic complex is at the heart of

all present discussions about the dispersal of human populations and migration of diverse human groups from one region to the other. Genetic data of different population groups reveal their ancestral relationship and the gene flows from one to the other. In the followings we shall draw upon this accumulated knowledge and frequently refer to the genetic aspects of this discussion.

The basis of genetic studies is the monitoring of molecular changes that have progressively occurred in the genetic material of humans through generations. These changes have been preserved in the genomes of the present-day populations in the form of randomly accumulating mutations. Besides the ongoing differentiation driven by mutation there is a process known as random genetic drift, whereby population expansions and contractions will tend to catalyze the random sorting of genetic differentiations in populations, further exaggerating the differences between them.

Since successive generations of mutations can be traced back to a root, their likeliest descent order form a genetic tree. Using a high enough number of informative molecular markers it is possible to find a geographic separation between different branches of the tree constructed in this way. This ‘phylogeographic’ approach can in principle provide clues regarding both the peopling of a region of interest and about subsequent population movements into it, as well as bearing witness to demographic processes of the past, such as bottlenecks and expansions. mtDNA and Y-chromosome DNA surveys on populations worldwide have divulged continent-specific distributions of basic mtDNA and Y-chromosome DNA clades or haplogroups and this information is liberally used in tracing the movement of population groups from one region to another.

After years of focus on the maternally inherited mitochondrial DNA, the paternally inherited Y chromosome is now providing complementary data, and comparisons between the two are yielding surprises. And the recently published human genome sequence, with its catalog of human genes and listing of the many variations seen in our DNA sequence, offers a new wealth of data for detecting the evolution as well as movement of our ancestors.

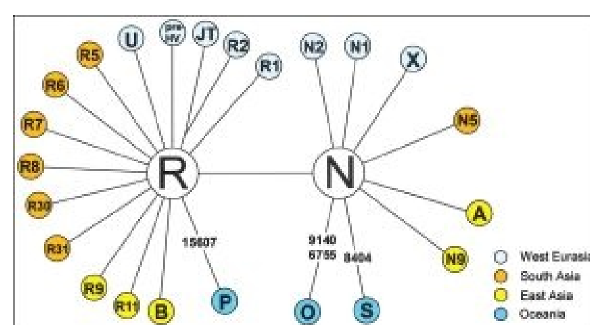
Genetic studies are, of course, not an answer to all questions and the methodology has its own critics. Consequently, there are a large number of skeptics who tend to downplay the significance of genetic trees and consider them a harmful diversion from serious demographic studies. The problem of countless bottlenecks which are often indicated in genetic studies is pointed out as counter to the intuitive logic. In view of the geographical relationship of genetic diversity, which cannot be denied, and in view of the problems that genetic tree approach faces, the concept of assimilation, hybridization, and demic diffusion rather than a a series of discrete migrations is currently gaining ground as an alternative approach to human origin and dispersal.

Doubts and skepticism notwithstanding, genetic studies do provide us with some concrete bases for explaining the genetic interaction of neighboring populations and identifying the population ’ouliers’ in major population groups. These studies are of particular utility for transitional regions, such as Pakistan and Central Asia, where not only the discrete gene flows emanating from surrounding areas are discernible but also some strange genetic or ethnic groups, having very little relationship with the surrounding populations, are observable. Such examples are the Makrani population group in the South of Pakistan and the Hazaras in the west. In view of the usefulness of these studies therefore, we shall spend some time to review the genetic landscape of Eurasia and see where Pakistan fits in this broad picture. We shall not try to construct any genetic trees but still treat the haplogroups as though they were the branches of such trees and the haplotypes as though they were the leaves on these

branches; all this to gain some idea about human dispersal in Eurasia in the distant past.

As stated earlier, there are two types of lineages that are commonly researched. One is based on the genetic material that is transmitted from mothers to daughters, the so called mtDNA lineages. The other is Y-chromosome DNA lineages that are based on genetic material which is transmitted from father to the son.

mtDNA Lineages: Mitochondria are tiny intracellular bodies that generate the energy needed to drive the activities of a cell. They have their own DNA, distinct and independent from nuclear DNA, which is located within the cell. Mitochondrial DNA can be 'fingerprinted' according to small variations in sequence and, because mitochondria is only inherited from the mother, it is used to trace maternal ancestry. Closely related mitochondrial DNA sequences fall within the same 'haplogroup', and insinuate - but do not prove - a close genetic relationship between the people who carry them.



Macro-lineage N gave birth to the lineage R. It is quite common in South Asia as well as in Europe and East Asia. The subclades of N and R are distributed not only in South Asia but also in Europe and the Orient. This diagram identifies a few of them and assigns to them their respective

area of high frequencies, making them region-specific

In human genetics, mitochondria DNA Haplogroup M is an enormous haplogroup spanning many continents. It is a branch of the African haplogroup L3. Another mtDNA haplogroup is N, which is probably also of African origin, like M, or at least a major offshoot of M. The two haplogroups M and N are believed to represent the initial migration of modern humans out of Africa. Haplogroup M in particular represents the dispersal of modern humans into South Asia some 60,000 to 80,000 years ago along the southern Asian coastline. Owing to its great age, haplogroup M is one of those mtDNA lineages which does not correspond well to presentday racial groups, as it spans Siberian, East Asian, Southeast Asian, Central Asian, South Asian, Melanesian as well as Ethiopian, Caucasian, and various Middle Eastern groups in lesser frequency. The haplogroup N, on the other hand, is prevalent in the Near East and Europe, where M is practically absent. Haplogroup R is an early offshoot of N. Their own offshoots are region-specific, as depicted in the figure below.

The most widely used genetic method works back to find the last common ancestor of any particular set of lineages using samples of mtDNA in current populations. Through some statistical manipulation of data and a liberal use of assumptions it is possible to date the stem of any genetic branch. This is called the *coalescence date*. For instance, coalescence dates for haplogroup M, which is shared by most non-European populations, average to between 73,000-55,000 years ago, that is to say that the human population with a predominance of M haplogroup was borne *ca.* 70,000 years ago (103). This is obviously contradictory to the generally accepted date for the emergence of modern

humans between 150-200,000 years ago.

This apparent conflict between the archaeological-based timings and those derived from genetic calculations probably stems from the diffused and rather wide the temporal window obtained from molecular genetic calculations. Newer methods are refining these calculations by taking into account the process of natural selection - which researchers realized was skewing their results - and has been tested successfully against known colonization dates confirmed by archaeological evidence, such as in Polynesia and the Canary Islands. Natural selection's very gradual removal of harmful gene mutations in the mtDNA produces a time-dependent effect on how many mutations one sees in the family tree. Nevertheless, for the first time the data from the whole of the mtDNA molecule have now become available and this should give the scientists a new or better tool to correct the aberration.

Y Chromosome Lineages: Of all the African male lines present before the exodus, only one gave rise to all non-African male lines or clans. This man had a rather important, random mutation on his Y-chromosome sometimes around 50,000-80,000 years ago. He has been named M168. We can figuratively consider him the Eurasian Adam. M168 gave birth to three male lines: C, DE (or YAP) and F. The descendants of C are the most numerous in the world, let alone outside Africa, accounting for around 90 percent of the non-African lineages. Because of its diffusion over a large geographical area, it is hard to precisely determine the direction of its expansion and the dates of specific events. Nevertheless, quite useful information about population migrations and dates based on Ychromosome DNA have started to accumulate in recent years. These data largely compliment those gathered from mtDNA analyses although sometimes the two sets of data are at odds with each other.

Human Dispersal to South Asia and onward to Australia and the Far East: The spread of early humans from Africa to Eastern Asia is usually depicted by employing large, illustrative arrows through broad corridors traversing through the subcontinent but, surprisingly, few attempts are made to look for details. Notwithstanding the difficulties encountered in such contemplations, three distinct possibilities arise. One is that the early humans primarily spread via coastlines. Coastal migration along the South Asian coastline to reach the far end of the Asian continentis one of these cases. Turner and O'Regan (57,111) provide evidence that indicates hominin use of the littoral zones in different continents, pointing out that hominins may have had the ability to cross water bodies to reach islands. The second alternative is that humans reached the Indian subcontinent via the southern route up to the Indus Delta and then dispersed through various river basins northward, ultimately crossing over into Indian mainland through northern Punjab, all the time hugging the Siwaliks and remaining in the shadow of the Himalayas. A third possibility is that the early humans spread through a directionless diffusional process like so many other species have done in the past. Under this scenario, the dispersal of humans across the Old World is envisaged as a random process of human migration, effectively directionless but affected by desert or rainforest, mountain or plain. Unfortunately, South Asia presents no supporting evidence for any of these paths and very few early hominin sites have been located. No fossil signposts are to be seen either.

At the present time, the Out-of-Africa migration and dispersal through the ‘Southern Coastal Route’ is a popular hypothesis among prehistorians, anthropologists, and archaeologists alike (28,34, 112, 113,114) to account for the dispersal of modern humans in South Asia and onward to the Far East and Australia. The arguments are mainly based on genetics. This scenario has been eminently explained and advocated for the common public by Stephen Oppenheimer (101) and Spencer Wells (115) and since then by several other prehistorians and archaeologists. According to this scenario, and put in

simple language, some 70,000 years ago, a small number of ‘modern’ humans, probably not more than 1000 individuals (some would say, only 200), crossed the Bab-el-Mandab at the southern tip of the Red Sea into Yemen. They multiplied in this new territory as they migrated, generation after generations, along the coastline of Arabia, the Persian Gulf, southern Iran, coastal Makran, Indian coastline, and most of the extant islands off the Indian coast, all the way to Thailand, Malaysia, the Philippines, and Indonesia, ultimately reaching Australia by 40,000 years ago and East Asia (Korea, Japan) by 30,000 years ago.

Along its way to the East but before it reached Indian coast, this group of people apparently split into two genetic groups, one branch, mainly represented by N and its offshoots, moving northwestward to the Levants, colonizing the Near East, Europe, northern Iran, and central Asia all the way to Siberia. The other branch, mainly represented by M and its offshoots, continued expanding eastward towards Pakistan, India, the Southeast Asia, all the way to Australia (101,116). This split could have happened in Arabia itself or further down in the area of coastal Iran or even the Indus Delta (97,101). This was essentially a coastal route and it is called as such (see fig. below). This is supposed to be the only exodus of modern humans out of Africa and all the present day humanity is the offspring of that small group of adventurers who originally came out of Africa.

The Southern Coastal Route is essentially a product of genetic investigations. But, it has also been advocated on the basis of lithic technology. Carl Sauer, a strong proponent of southern coastal route migration, for example, pointed out in 1962 that a coastal pattern of dispersal would make good sense in ecological and demographic terms, because this would presumably have required only limited economic adaptations from one coastal location to another. A strong theoretical treatment in favor of human dispersal through southern coastal route has been recently offered by Field, Petraglia, and Lahr (117,118).

In a summation of evidence, Mellars (27) claimed that the southern dispersal route was firmly established at 60,000 years ago and this event was marked by crescentic blade and microblade industries and symbolic traits associated with modern human behavior. Mellars linked crescentic tool forms found in Sri Lanka, India and Pakistan to African industries, such as Howieson’s Poort, and further more, observed similarities in engraved pieces found at Blombos, South Africa, to those of Patna in India. To Mellars, this strongly indicated a direct connection between early human colonists in Asia and their ancestors in Africa.

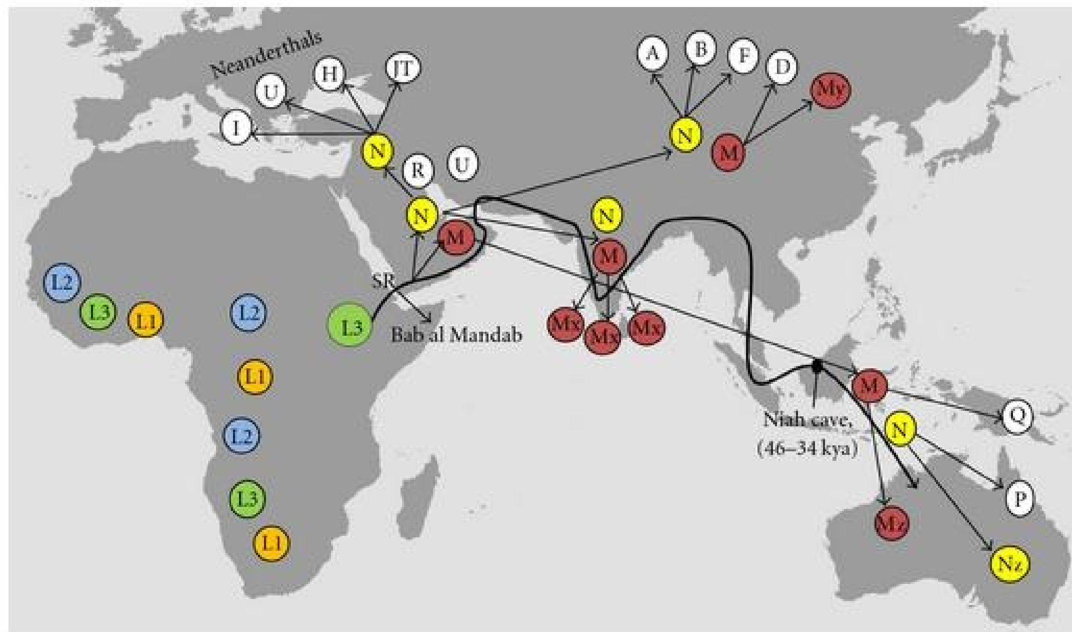
India has the greatest variety of M subclades. When we look at the oldest M branches, we find a date of 73,000 years in India (119), 74,000 years in Central Asia (74), 75,000 years in New Guinea (69), and 68,000 years in Australia. No data on M lineages from Pakistani populations are available but looking at those from the surrounding areas we are safe to assume the local age of M in Pakistan to be around 70,000-75,000 years. These dates are much older than those derived from many earlier archaeological considerations and rather younger than the most recent archaeological thinking (e.g. Jebel Faya discoveries as well as those in South China). Furthermore, there seems to be virtually no temporal gradient across the region. Taken this data on its face value, it would appear that the Indian subcontinent and the areas around it was colonized more-or-less all at the same time as that of south-western Arabia and the tip of the Persian Gulf.

Recent study of the Andamanese mtDNA support the interpretation for a rapid colonization of the region towards Australia (89,114,120) but, again, the genetically derived temporal horizon is at odds

with recent archaeologically driven conclusions referred to above. The genetic evidence of South Asia, especially that of India, indicates a predominantly late Pleistocene heritage with no major population replacement events in later periods (120). This also gives support to the hypothesis of rapid coastal migration. Interregional analysis of contemporary and recent crania provide additional support for this hypothesis, indicating that the Indian populations form a relatively distinct and homogeneous cluster, which suggests that demographic expansion within India was in situ throughout much of prehistory. Now, if these dates are agreed to and the majority opinion for African Exodus during 65,000-70,000 years ago is also maintained, there is not much of a time lag between the crossing of the Bab-el-Mandab by the founding fathers (and founding mothers) and settling their progenies in India. These objections are explained, as mentioned earlier, through the thesis of a *rapid* migration along the coastline (55,89), a notion that is still prevalent in archaeological circles but still an untenable proposition.

Because of these problems, Petraglia et al (76) recently suggested that modern humans were present in Arabia and South Asia earlier than currently believed, and probably coincident with the presence of Homo sapiens in the Levant between ca 130,000 and 70,000 years ago. This hypothesized spread of modem humans in the subcontinent before 60,000 years ago has important demographic and cultural implications (64). If such dates for South Asia are valid, it would imply that modem humans expanded into the region using Middle Paleolithic technologies. And if this is the case, modem humans would have likely encountered archaic hominids, also using Middle Paleolithic technologies. Such an encounter has more in common with the interchange of modern and archaic populations in West Asia and contrasts with models which proposes that modern humans expanded out of Africa after 60,000 years ago, employing an 'Upper Paleolithic' package.

Lithic literature, ranging from the Middle



Paleolithic to the Mesolithic, is immense in India and Pakistan. Most of these studies, however, are local and without any connecting thread for the whole region. On the basis of these disjointed and isolated studies attempts have been made to connect the lithic technologies from this region to those in Africa and thus deriving a temporal horizon for the arrival of the modern man. These connections

span over the Middle Paleolithic technology on one hand and to the Mesolithic (Microlith) artifacts on the other and it is difficult to find a common theme. It will,

Map showing the geographic distribution of ancestral mtDNA haplogroups of mod ern humans in Africa and Eurasia between 60 and 30 kya, after Forster . Note that

therefore, by futile to discuss these studies as they do not **Figure 3:** Map showing the geographic distribution of ancestral mtDNA haplogroups of modern humans in Africa and Eurasiashed any light on the dispersalbetween 60 and 30 **all the ancestral haplogroups now found in Eurasia are believed to have branched**

kya, after Forster ([49, page 258], Figure 2). Note that all the ancestral haplogroups now found in **from L3, which originated as a founder in eastern Africa around 85 kya. The thick** of modern humans in this reEurasia are believed to have branched from L3, which originated as a founder in eastern Africa around 85 kya [11]. The **bold line indicates the general pathway of the southern dispersal route (SR) along the** gion. The same applies to thethick bold line indicates the general pathway of the southern dispersal route (SR) along the circum-Indian Ocean.
circum-Indian Ocean. timings. Most of the publish literature, based on genetic stud

The theory of African exodus *ca.* 60,000 years ago and the raid expansion of modern hu mans along the southern coastal route can probably explain the presence of man in the Far East ca. 45,000 years ago but it fails to explain some recent discoveries, such as the stone artifacts dating ca. 130,000 years ago at Jebel Faya (126), or the dis covery of modern looking human fossil in South China (75), dating more than 100,000 years ago. Neither this scenario jives with the results of mo lecular genetics which generally show coalescence points of M lineages in Indian populations as 50,000 years ago and older.
ies, somehow arrives at the

coalescent dates that span from 50,000 to 70,000 years ago. These dates neither support the southern exodus *ca* 50,000 years ago and rapid eastward expansion thereafter, nor do they accord with the more recent archaeologically-derived dates of 130,000 years ago for the African exodus (Jebel Faya evidence, Levant evidence) and ca. 110,000 years ago for the far end of the dispersal train (the South China evidence). In short, the situation is confused, to say the least.

Comparatively Late Dispersal to Levant and Europe: Equally important is the question as to how the early humans reached the Levant, Europe, and that too a considerable time after they had already colonized South Asia and reached Southeast Asia and Australia. It should be recalled that an early presence of modern humans in the Levant had been indicated around 100,000 years ago but this population either perished or shortly moved elsewhere. Modern man reappears in this part of West Asia around 50,000 years ago, much later than the known presence of modern humans outside Africa - in Arabian peninsula and UAE prior to 100,000 years ago, in South Asia around 70,000 years ago, East Asia around 60,000 years ago, and 110,000 years ago in China.

Mellars (96) describes two phases of modern human dispersals from Southwest Asia into Europe: (i)

initial occupation of southeastern Europe around 43,000 years ago, (ii) followed by a westward movement along the Danube Valley that led to the occupation of central and southern Europe around ~40,000 years ago. Two possible source areas have been suggested for the reoccupation of Southwest Asia by anatomically modern humans around 50,000 years ago: (i) expansion of Later Stone Age populations from NE Africa toward the eastern Mediterranean Levant through the Nile corridor during MIS-3 (59,000–27,000 years ago) warm intervals (25,37), (ii) a south-north expansion from Arabian Peninsula to the Levant by human groups who previously entered the Arabian Peninsula either through the Bab al Mandab or through the Levant (27,81,97).

On the basis of new paleoenvironmental, archaeological, and genetic evidence from the Arabian Peninsula and southern Iran, Rose (81) has recently formulated an enticing model dubbed the "Gulf Oasis," in which he proposes that "early modern humans were able to survive periodic hyperarid oscillations by contracting into environmental refugia around the coastal margins of the peninsula". Based on this model, the author hypothesizes that the Persian Gulf may have been a source area for Upper Pleistocene human diffusion to Southwest Asia, *as well as* to South Asia and possibly back to East Africa. At the center of the model lies the assumption that sea level decline during arid periods (associated with glacial episodes) enhanced the discharge of fresh water from terrestrial aquifers along the continental shelves, thereby creating favorable habitats along the Gulf basin when much of the hinterlands were dry (98). The presence of subterranean freshwater upwells beneath the Persian Gulf has been confirmed by geological studies. While the Gulf Oasis model sets a plausible scenario for Upper Pleistocene hominin diffusion from Arabia, it can be critiqued based on the lack of evidence (so far) for *in situ* origin of any of the two ancestral haplogroups - N which went to the northwest and M that went east - in Arabia or this Persian Gulf refugia (99,100).

Very similar to the above model, there is distinct possibility that humans geographically remained confined to the southern regions, mainly along the coast of the Indian Ocean, till the amelioration of the climate around 50,000 years ago at which time a section of the expanding population moved northward into the Levant and Central Asia while the bulk of the population continued their generational journey eastward along the sea coast and river basins. Starting with a firm stand on the southern route hypothesis, Oppenheimer takes this possibility seriously as he explains the late colonization of Europe quite eloquently and rather convincingly in his *The Real Eve*. His argument is mainly genetic and we attempt here a summary.

The argument centers on N and M lineages that characterize the whole of humanity outside Africa (91,101,102,103). The Haplogroup M is more prevalent in Asia and is rather diffused. It is most concentrated in India but is surprisingly not present in Europe. N is centered mainly in the Near East and Europe. It is also present in Asia where M is also strong. This dichotomy shows that the Europeans and the peoples of the Near East came not directly from East Africa, otherwise M lineage would have been present in Europe as it does in other parts of the world. In this sense, the colonization of Europe seems to be a side scene in the main play.

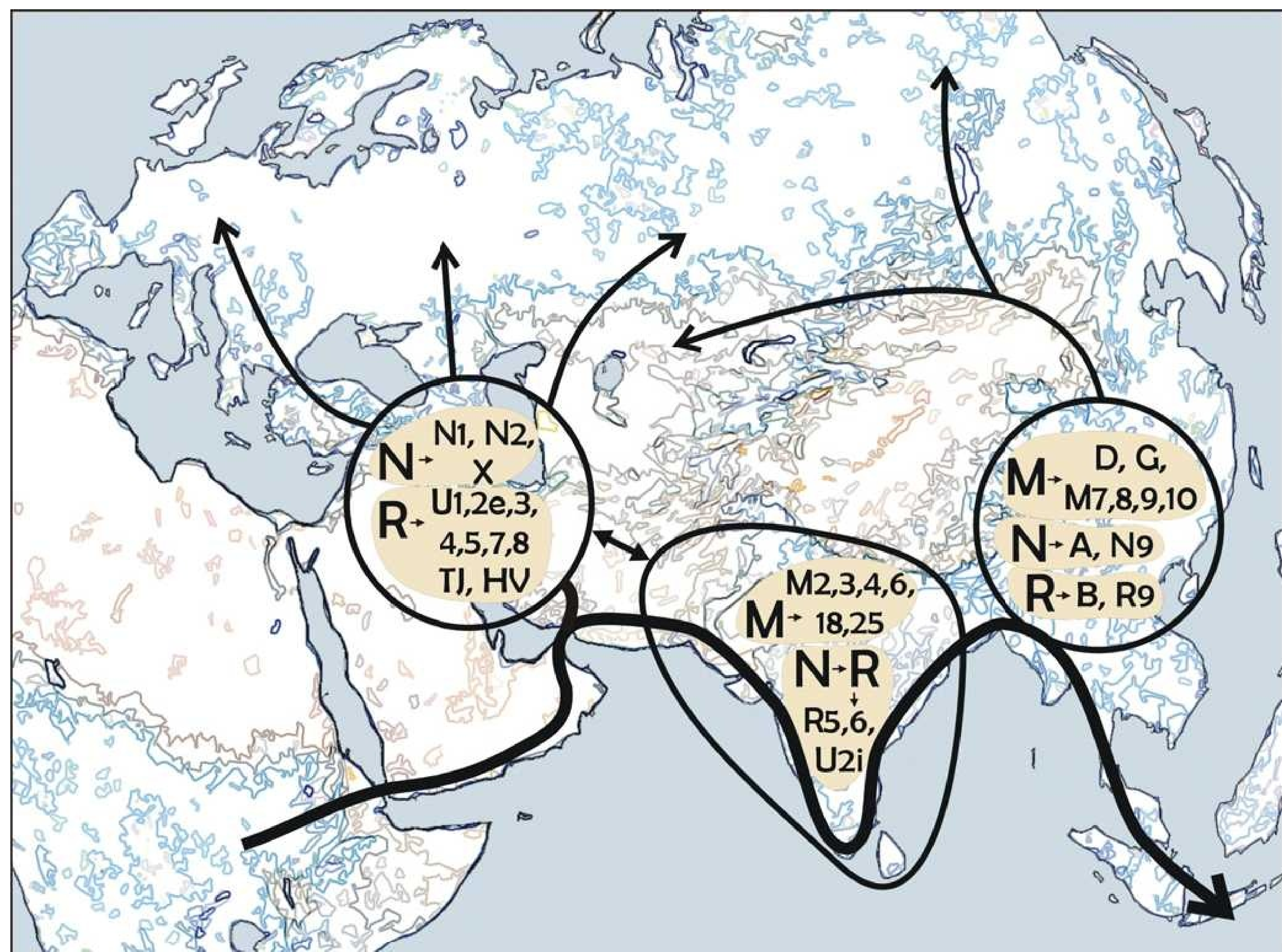
According to Oppenheimer (101), the N and M lineages bifurcated in the region between the Euphrates and the Indus delta, the so-called Gulf Oasis. Oppenheimer's center of gravity is around the Persian Gulf or perhaps the Eupherates Delta in the present day Iraq. After a brief pause in this region, Oppenheimer hypothesizes, human race started to diversify and one of its branches, represented by lineage N, expanded into northern territories of the Near East and Europe as well as those of Central Asia when climatic conditions became favorable, around 50,000 years ago. Toomas

Kivisild and coworkers (97) seem to back up this picture through their mtDNA and Y-chromosome investigations of the present day populations of the area. However, their center of gravity seems to be the Indus Delta (see fig. below). We shall touch upon this work again in another chapter within the present Section.

N also gave birth to other sub-lineages, such as R and U and these lineages then ended up populating the Near East *ca.* 40,000 years ago and Europe a little later. This is to say that Europe was colonized by a sub-group of the same Out-of-Africa migration that populated South Asia and the Orient but quite late in time. Furthermore, this bifurcation of the two groups took place not right after the exodus from Africa but considerably later.

The timing of this northwesterly movement is predicated on climatic factors. It is logical to believe that the access between the coastal area of the Indian Ocean and that around the Mediterranean was always blocked by desert during glaciations. Almost exactly 50,000 years ago, however, there was a brief but intense warming and greening of this area, with monsoon conditions better than today. This climate improvement can be detected as a carbon-rich layer in the undersea delta of the Indus (104). Since the warm spell lasted perhaps only a few thousand years, geologists call it an 'interstadial' rather than 'interglacial', but the effect on the dormant Fertile Crescent was the same. For a short while that narrow green corridor opened, allowing migration from the Persian Gulf (or the Indus Delta) to the Levant.

Such a picture of Europeans' genetic roots in South Asia fundamentally changes the Eurocentric view of Europeans as the first fully modern human culture outside Africa. It also puts the Iranian Plateau, in fact the whole South Asia, at the center of human dispersal. Some anthropologists, such as Otte et al, (104,105) propose a similar scenario but concentrate on Zagros Mountain range in the present-day ethnic region of Kurdistan, just north of the Gulf, which they argue was the core region for Upper Paleolithic technology. The evidence from Pakistan, especially from Sindh in Pakistan and Kerman in Iran is also revealing, although not securely dated. Here the Upper Paleolithic type tools have been cited long before 40,000 years ago, which is the conventionally cited date for the starting point of the Upper Paleolithic industry in the Levant and Europe.



A most probable dispersal route based on genetic Evidence (97)

The strongest argument for this scenario is the fact that modern man reached the Levant and Europe with a bang. The change in lithic technology around 40,000 years ago, known as the Upper Paleolithic, was so pronounced that it has been dubbed as a 'revolution'. The assemblages are characterized by completely different and much improved tool-making technology, which had no relationship with the previously existing technology. Such a 'revolution' or 'great leap forward' is evident nowhere else in Africa or Asia wherein the technological change has been gradual. It appears that the modern man reached Europe with a mature set of technology that was developed elsewhere - probably in the Gulf Oasis Refugia, probably around the Euphrates Delta, perhaps in the Zogros mountains, or perhaps even in the Indus Delta. The evidence from Africa is rather weak.

From an Asian point of view, Europe is an inaccessible peninsula jutting out northwest from the Old World, a geographical *cul-de-sac*. Genetically as well as geographically, Europeans are a side-branch of the out-of-Africa human tree. Because the first non-African modern humans were Asians, peninsular Europe was more likely to have been recipient and beneficiary of the seeds of the earliest Upper Paleolithic cultural innovations rather than their homeland. From this perspective it is essential that we deconstruct the archaeological myth of a major human biological and cultural revolution in Europe and the Levant, with everyone else in the world following the European lead.

In summary, after coming out of Africa, modern humans first spread to South Asia following the coastal route up to the area that lies around the Persian Gulf or the Indus Delta. Here they bifurcated into two branches: one is represented by haplogroup N and the other by haplogroup M. Genetically submerging N, the haplogroup M and its related clades became entrenched in South India, populating the surrounding area and transmitting the M-related genetic material to South East Asia. The N lineage and its sub-clades, notably R, moved northwestward and populated the Near East and Europe. This also gave a posterior radiation to Caucasus and Central Asia. Subsidiary migrations also occurred through the river valleys northward from the main migrating stream along the coast of the Indian Ocean. These populated the interior of the Asian continent. There were also returns to Africa, one from the original exodus route to transmit subclades of M, and one from the Near East to North Africa to transmit several subclades related to the Near East and Europe.

What About Central Asia? Discussing the routes of the initial modern humans dispersal in Asia one cannot leave Central Asia without attention. It seems that this region was populated quite early on and therefore could have provided an important substrate for the population development in the area in its vicinity and must have affected the genetic mix of Afghanistan's and Pakistan's early populations. The mtDNA and Y lineages typical of East, West and South Eurasia are found in populations of Central Asia (106,107) and this cocktail of lineages, derived from different sources, significantly increases the diversity present in the region. It is therefore not always easy to decide whether populations showing high levels of genetic heterogeneity have gone through recent admixture, receiving gene flow from multiple distinct sources, or if they have evolved in long-term separation from other populations.

How does the Oppenheimer's hypothesis explain the colonization of Caucasus, Central Asia, Afghanistan, and the interior of Pakistan and India? Oppenheimer visualizes the colonization of the Caucasus and Central Asia by the convergence of two migration flows, one from the Levant after its own colonization around 45,000 years ago, and one a northward movement from the Gulf area, mainly along various rivers and water streams, around the same timeframe. In context with Central Asia, the the flow from the Near East was much more significant than that from the South. Genetic evidence, discussed later in Chapter III.4, gives credence to this general hypothesis.

As the steppe hunters migrated eastward from the Near East, generation after generations, carrying Eurasian lineages into the interior of the continent, they encountered the most significant geographical impasse so far. These were the great mountain ranges that define the southern central Asian highlands – the Hindu Kush running west to east, the Himalayas running north-west to southwest and the Tien Shan running south-west to northwest. The three ranges meet in the center, at the so-called *Pamir Knot* in present-day Tajikistan, and each radiates off like a spoke in a wheel. The world was in the grip of the last Ice Age, and temperatures would have been extremely low. Here our Eurasian migrants came to temporary halt and split into two groups – one eventually moving to the north of the Hindu Kush, the other to the south, into Afghanistan and Pakistan.

Those who headed north had additional mutations on their Eurasian lineage. One of them was known as M45, and it will help us to trace two very important later migrations if we chose to follow the trail northward. Using absolute dating methods, we can infer that the M45 mutation occurred approximately 35,000 years ago in Central Asia. Today, M45 is found only in Central Asians and those who trace their ancestry to this region. Descendants of this Central Asian clan occurs only sporadically in the Middle East and East Asia, but at somewhat higher frequency in Pakistan where the

clan appears to have migrated much later. They are also present in northern India, although at lower frequencies.

Those who headed South, had an unrelated mutation on their Y-chromosome known as L(M20). L(M20) is currently present in the western parts of Pakistan, especially in the Derajaat and Baluchistan (28%). A high frequency (approaching 50 per cent) of L(20) was reported in the upper and middle castes of south India and repeated endlessly in Indian anthropological literature (63,108,109,110). This was recently found erroneous for some shortcomings in sampling. The presence of M20 lineages in South India is, therefore, at best a questionable proposition, if not completely irrelevant. Judging from the presence of all three variations at substantially high frequencies on the western banks of the Indus, it appeals to logic that L(M20) and its sublineages are confined to Pakistan only.

Genetically, Central Asia is amazingly complex region. On top of it, this region has not been sufficiently studied. It is, therefore, not easy to reconstruct the dispersal of humans in this region. Whatever information we may have, does not exactly fit in the picture we have drawn above in relation with that of the Near East, Europe, and South Asia. Nonetheless a general direction is clear: the current populations are an extension of those from the West on one hand and from the Southeast on the other. There seems to be little genetic contribution from South Asia, including Pakistan. However, as mentioned earlier, the reverse may in fact be true. There has been a strong current of human migration from the Pamir Knot to Pakistan, even penetrating India, some 30,000 years ago and countless outflows of Central Asian genes in later times. We know about these dispersals through the study of mtDNA but more so through the Y haplogroups, the so-called male lineages. Since male lineages are genetically independent of the female lineages discussed above, a perfect match between the two cannot be expected. This West-to-East trend of gene flow is evident even in the historical times.

Problems with Conventional View: The human dispersal scene, drawn in the preceding pages, is by no means an open and shut case and there are a number of questions that still remain unanswered. Discussions about modem human dispersal out of Africa rely on very limited fossil and artifacts finds. There are no fossils to corroborate the presence of modem humans in South Asia, other than the skeletons of *Homo sapiens,* dated to *ca.* 31,000 years ago at Fa Hien Cave and *ca.* 28,500 years ago at Batadomba-eIna in SriLanka. Thus, paleoanthropological formulations of migrational routes have been mostly theoretical, drawn from evaluation of genetic evidence. The genetic coalescence dates for the arrival of modem humans in the subcontinent, together with the earlier range of the Australian dates, plausibly indicate the presof the Australian dates, plausibly indicate the pres 55,000 years ago. None of these two areas of investigation is beyond reproach.

The most viable critique to African origin of modern humans and the single rapid dispersal hypothesis comes from four concurrent lines of evidence:
(i) a growing body of recent genetic evidence that shows *in situ* origin of haplogroups M in South Asia (93,121,122, 123, 124, 125)
(ii) the recent discoveries of a well-stratified Middle Stone Age/Middle Paleiolithic assemblage in Eastern Arabia (*Jebel el FayaJebel el Faya* 120,000 years ago (126) and modern human fossil remains from Zhirendong cave in southern China dating to >100,000 years ago (75),
(iii) a recent multivariate analysis of morphometric data that shows close genetic affinity between early modern humans from the Levant and terminal Pleistocene/early Holocene fossils from Australasia (127), and

(iv) a more recent genetic study on the Neanderthal nuclear genome that shows that Neanderthals shared more genetic variants with present-day humans in Eurasia than with present-day humans in sub-Saharan Africa (128) .

By examining genetic diversity among Asian and North African extant populations, Olivieri et al. (121) and González et al. (122) propose an Asian origin of haplogroup M and its back migration via the Sinai land bridge into Africa sometime between 45,000 and 40,000 years ago. In this regard, González et al. write, “The coalescence age of the African haplogroup M1 is younger than those for other M Asiatic clades. In contradiction to the hypothesis of an eastern Africa origin for modern human expansions out of Africa, the most ancestral M1 lineages have been found in Northwest Africa and in the Near East, instead of in East Africa.” Rowold et al.(128) back migration of through the Sinai land bridge. The possibility of back migration from Asia to Africa has also been confirmed by other genetic studies on human Ychromosome haplotypes. Further indirect evidence for an Asian origin of haplogroup M comes from recent studies on the genetic diversity of the Arabian populations, which show stronger influence of South Asian N and M haplogroups in the founding lineages of the Arabian mtDNA (123,129,130). Interestingly, much of the existing genetic ties between NE Africa and Arabia have been attributed to historic contacts between Afro-Arabian kingdoms (129). In light of the growing genetic data in favor of an Asian origin of haplogroup M (one of the two founding mtDNA haplogroups for all modern humans outside of Africa), there appears to have been an Asiatic locus/loci of Upper Pleistocene human expansions.

As discussed earlier, a diagnostic MSA/MP assemblage has recently been identified at the site of Jebel Faya, UAE (29,126). Its date falls in the range of MIS-5 (127,000–95,000 years ago) and is considered to be the oldest evidence of modern human dispersals out of Africa prior to the purported rapid coastal migration (35). The period between 100 and 50,000 years ago is poorly represented by fossil hominins and well-dated Paleolithic assemblages outside of Africa. In this regard, some scholars (27,80) hypothesize that the initial migration of modern humans from Africa (represented by Qafzeh and Skhul fossils) did not result in a widespread human expansion outside the Levant. The identity and contribution of the Jebel Faya humans to the Upper Pleistocene colonization of Eurasia is unknown, but given its pivotal location en route between Northeast Africa and South Asia, the evidence is of a paramount significance in assessing the timing and the geographic contexts of early modern human dispersals. Early modern humans that originated in Africa around 190,000 years ago may have subsequently migrated to Arabian Peninsula during MIS-6 through the Southern Route. From Arabia, some modern human groups may have launched an eastward migration along the Arabian-Iranian-Indus coastal refugia reaching provide additional evidence for Upper Paleolithic populations southern China around 100,000 years ago (75). Subsequently, hominins specifically adapted to those putative refugia may have served as founder populations for later human expansions into East Asia and Australia. This is a major modification to the chronology of human dispersal in Asia and is closer to the genetic calculations than archaeological dating.

The Australian genetic and fossil records have been important in calibrating Upper Pleistocene human dispersal events at various points in time. The oldest archaeological traces of early modern humans in Australia have been dated to ~50,000 years ago at the sites of Lake Mungo (131) and Devil's Lair (86). Geneticists extend the arrival of humans in Australia up to 60,000 years ago or somewhat earlier. A recent multivariate analysis of cranial morphometric data has shown close genetic affinity between early modern humans from the Levant (Qafzeh and Skhul) and terminal Pleistocene/ early Holocene fossils from Australasia (132). According to the study, an early dispersal

(before 100,000 years ago) from Africa by a more ancient lineage of modern humans may have contributed to the initial colonization of Australasia, thereby suggesting a direct contribution of the Qafzeh and Skhul groups in peopling Eurasia during the Upper Pleistocene.

The fourth source of disagreement with the single dispersal hypothesis comes from a recent genetic study on the Neanderthal genome, which shows that Neanderthals shared more genetic variants with present-day humans in Eurasia than with present-day humans in sub-Saharan Africa (128). From this, the authors of the study conclude that “gene flow from Neanderthals to the ancestors of non-Africans occurred before the divergence of Eurasian groups from each other”. Although it is too early to speculate much about this finding, the study offers a plausible scenario for deep genetic roots in Eurasia and hints that the initial dispersal of modern humans into Southwest Asia associated with the Qafzeh and Skhul groups was not a failed one. Perhaps, that expansion may have ultimately resulted in early modern human and Neanderthal contacts/interbreeding in Southwest Asia. Modern human groups with Neanderthal genetic material may have survived in Southwest Asia throughout the succeeding millennia giving rise to some ancestors of present-day Europeans and Asians. This, of course, smacks of the Multiregional theory of human origins and dispersal.

Genetic foundation is the strength of the currently popular southern dispersal model but it is also its weakness. As new data accumulate, several questions about their interpretation arise. mtDNA and Y chromosome analyses assume that modem sampled populations are an accurate reflection of all past populations. Such studies rarely consider the effects of major demographic changes (population expansions, contractions and extinctions) resulting from climatic fluctuations in the Late Pleistocene, as well as from potential Holocene processes of the spread of farming and farmers. Since genetic studies center on modem populations, coalescence ages measure reproductively successful lineages rather than providing a history of all lineages that may have been present. Forager populations that once thrived in certain areas, such as deserts (e.g. the Empty Quarter of Arabia, or the Thar Desert of the Indian subcontinent), may have become extinct, so that their gene pools are no longer available for sampling in contemporary populations. Moreover, mtDNA mutation rate estimates suffer from calibration shortcomings, leading to widely disparate ages for estimating the timing of the dispersal (76).

There is also the more fundamental demographic founder relatively small population units expanded progressively eastward (133,134). Some gross errors in population sampling have also occurred. For example, in the case of Pakistan, the sampling of ‘southern Sindh’ has been done in Karachi, forgetting that this population in no ways represent that of ‘southern Sindh’; instead, it is more representative of the Middle Ganga (the Mohair population from India).

Apart from the doubts expressed on the validity of genetic data, we have the enigma of the absence of the Upper Paleolithic technology in South East Asia and Australia and the absence of a clear demarcation between the Middle and Upper Paleolithic in India and Pakistan during the time period that is frequently believed to be the time period of this human migration. The earliest stone-tool technologies documented across the whole of Australasia are conspicuously lacking in any trace of distinctively "modern" or "Upper Paleolithic," blade-based technologies of the kind recorded from both the later African Middle Stone Age sites and the earliest modern human sites in southwest Asia and Europe. These Australian technologies consist of very simple, flake-based industries, completely lacking in typical blade forms and apparently with little or no trace of typically Upper Paleolithic tool forms such as end scrapers, backed blades, or burins. How can we reconcile this observation with the

hypothesis that these technologies developed from more "advanced," blade-based technologies in Africa and dispersed by modern humans starting *ca.* 45,000 years ago? Similarly, while the arrival of modern humans is announced in the Near East by a sudden appearance of the Upper Paleolithic artifacts (blades and burins) and other manifestations of modernity, no such sudden change is in evidence anywhere in South Asia. Here the change is very gradual and a continuity with the Middle Paleolithic technology is maintained.

Recognizing these geographic biases and limitations, various researchers have sought to undertake more detailed and systematic studies in the overlooked but geographically critical regions of the Indian Ocean rim (135,136). Archaeologists, in particular, have begun to make substantive headway in and evolutionary issue effects, and associated of the repeated

cultural drift, as



synthesizing existing data and in conducting new field investigations in Arabia and the Gulf. While dating of archaeological sites, excavation of stratified archaeological deposits, and detailed stone tool analyses and inter-site comparisons continue to be more limited than is ideal, recent findings arising from current archaeological investigations, together with new genetic research, are providing fresh, if tentative, insights into dispersal processes (76). The recent discoveries of stone artifacts in UAE seems to be a fresh start.

Equally important is the interpretation of older data. Petraglia et al (76), for instance, have recently come up with an alternative synthesis and suggested that Homo *sapiens* expanded out of Africa using Middle Paleolithic technologies as opposed to Mode 4, so far believed. Substantive archaeological evidence in the form of dated Middle Paleolithic technologies in the Arabian-South Asian transit zone

now join early Homo *sapiens* data from the Levant in supporting such an inference (137). This view contrasts with the notion that expansions of Homo *sapiens* occurred at *ca*. 50,000 years ago, only after so-called modern cultural behaviors appeared (27) or that population movements occurred at 60,000 years ago based on a genetic coalescence age and the appearance of crescentic tool industries (138). The evidence for a dispersal to the Levant by Homo *sapiens* at 110,000-74,000 years ago may not be evidence of a failed dispersal; rather, they suggest, the Levantine populations may be one example of successful OIS 5 range expansion across Arabia and South Asia. Petraglia et al base this inference on new ages from Middle Paleolithic assemblages in Arabia (more than 85,000 years ago) and India (78-74,000 years ago), and their technological similarity to Middle Stone Age assemblages in Africa. These chronometric ages are beyond the coalescence ages of 70-50,000 years ago drawn from the modern human gene pool. All this means is that the first dispersal of Homo *sapiens* along the Indian Ocean rim may be considerably earlier than currently realized.

Summary and Conclusions: In spite of continued progress in all fields of paleoanthropology, the present generation is particularly confronted with a complex set of long accumulated conflicting views about the origin and dispersal history of early humans. This

chapter is an attempt to review the current state of the scientific debate on this broad topic, especially the Upper Pleistocene (128,000– 12,000 years ago) human dispersals out of Africa and their successive colonization of Asia. Researchers have often relied on archaeological, genetic, and fossil data to examine patterns of early human dispersals.

The Out-of-Africa model of anatomically modern human evolution posits an African origin 150,000–200,000 years ago, followed by subsequent dispersal(s) to Eurasia and other continents within the last 70,000-140,000 years. Although alternative models have been proposed, the out-ofAfrica scenario receives the most support both from archeological and genetic evidence. However, the route(s) followed by the African migrants remain poorly understood. One proposed route was through northern Africa toward the Levant, which finds support in the archeological and fossil records. This exit of modern humans out of Africa would have taken place during the Upper Paleolithic era (~45,000 years ago), which considerably postdates the earliest evidence of modern human presence in the Sahul (Sahul is the name given to the single Pleistocene-era continent which combined Australia with New Guinea and Tasmania). Indeed, luminescence dating, paleovegetation changes, and skeletal remains suggest that Australia was inhabited by modern humans by 60,000 years ago, implying a substantially earlier migration from Africa to Australia. Recent discoveries of early modern human fossil remains in the Zhirendong (Zhiren Cave) in south China have been dated at least 100,000 years old. To augment these discoveries, there are more than 120,000 years old stone artifacts from Jebel Faya (UAE, Persian Gulf) and southern Pakistan (Lower Sindh), if indeed these remains were made by modern humans. To take this evidence into account, as well as morphological and archeological features of many Australian fossils, a second migration of modern humans, known as the “southern route” hypothesis, was suggested to have occurred during Middle Paleolithic times (60,000-100,000 years ago) from eastern Africa to Sahul via South Asia.

With the advent of intensive research on modern human mitochondrial DNA (mtDNA), paleoanthropology attained a turning point; among other things, the genetic data reinforced the Out-ofAfrican origin theory and set out possible scenarios for human dispersals (139,140,141). African populations display greater genetic diversity, implying that Africa was populated by early human ancestors longer than any other region (139,142). From this, some geneticists hypothesize that all

modern human genes descended from a single population - dubbed "African Eve "- that lived in sub-Saharan Africa around 150,000 years ago . The Levant and the Arabian Peninsula play a central role in the current debate about hominin (humans and their ancestors) dispersal history due to their strategic location at the main gateways of biographic movements between Africa and Eurasia, so do Pakistan and southern India. All these regions have yielded rich Paleolithic and paleontological data that are useful in any discussions of prehistoric migrations out of Africa and vice versa.

However, these approaches have continued to suffer from a lack of consistent evidence from the contributing regions, such as the Nile Valley, the Levant, the Arabian Peninsula, and South Asia. Some, but not all, archaeological and genetic publications reviewed here, hint at multiple loci of Upper Pleistocene human expansions outside of Africa but, because of their preliminary and mainly speculative nature, only one point of human dispersal is often the stuff of our college and universities teaching. The same applies to single or multiple dispersals from Africa but here the taboo against a single exodus is rapidly breaking.

Human presence in South Asia appears to have persisted since the onset of the Last Interglacial (MIS-5) by relying on the expanding grassland habitat during wet phases and on environmental refugia during dry conditions. Many authors are in agreement with Rose's assertion that the Persian Gulf region may have served as a potential center for Upper Pleistocene human expansion to Southwest Asia or back to Africa, and this appears to be the source of the Upper Paleolithic populations in Europe.

The dispersal of modern humans in South Asia has not been well researched. The reviewed literature hints at two modes of early modern human colonization of South Asia in the Upper Pleistocene: (i) from multiple *Homo sapiens* source populations that had entered the Gulf Refugia during the MIS-4 and started expanding after the onset of the Last Interglacial (MIS-5). This especially applies to the colonization of Pakistan. (ii) From a rapid dispersal out of East Africa via the Southern Route (across out of East Africa via the Southern Route (across 100,000 year

A wealth of genetic data accumulating from South and Southwest Asia supports *in situ* origin of one of the ancestral mtDNA lineages - haplogroup M in South Asia, signifying an Asiatic source populations for population expansions, although not for initial colonization, of Eurasia in the Upper Pleistocene. This view contrasts with the "single dispersal" hypothesis, which posits that the founding lineages (M and N lineages) of South and East Asian populations were products of a single wave of modern human expansion from eastern Africa during MIS- 4, dating to 74,000–60,000 years ago. In conclusion, there does not appear to be a clear consensus on the exact timing and source populations for Upper Pleistocene human colonization of Eurasia.

AsreviewedbyEndicott,Metspaluand Kivisild (69), Y-chromosome and mtDNA data support the colonization of South Asia by modern humans originating in Africa. South Asian lineages, like others in Eurasia, belong to haplogroups M and N, apparently descended from the L3 haplogroup that arose in Africa ca. 85,000 years ago (142). Coalescence dates for haplogroup M, which is shared by most non-European populations, average to between 73-55,000 years ago (143). Based on a reading of the mtDNA and Y loci data, Endicott, Metspalu and Kivisild indicate that a single, early migration was responsible for the initial settlement of Eurasia and Australia. Recent study of the Andamanese mtDNA support the interpretation for a rapid colonization of the region towards Australia (144,145). Hence the genetic evidence of South Asia indicates a heritage with no events in later periods.

Interregional analysis of contemporary and recent crania provide support for this hypothesis, indicating that South Asian populations form a relatively distinct and homogeneous cluster, which suggests that demographic expansion within the subcontinent was in situ throughout much of prehistory.

The genetic evidence has been persuasive, but unfortunately there are no fossils to corroborate the presence of modern humans in South Asia, other than the skeletons Homo *sapiens*, dated to other than the skeletons of Homo *sapiens*, dated to ca. 31,000 years ago at Fa Hien Cave and ca. 28,500 years before present at Batadomba-lena . Nevertheless, the genetic coalescence date for the arrival of modern humans in the subcontinent, together with the earlier range of the Australian dates, plausibly indicate the presence of modern humans in South Asia between 70-55,000 years ago. If such dates for South Asia are valid, it would imply that modern humans expanded into the region using Middle Paleolithic technologies. And if this is the case, modern humans would be using Middle Paleolithic technologies. Such a hypothesis has more in common with the interchange of modern and archaic populations in West Asia, and contrasts with models which indicate that modern humans expanded out of Africa after 50,000 years ago, employing an 'UpperPaleolithic' package.

The GIS-based analyses indicate that entry into South Asia is more likely to have employed a coastal corridor that originated in the west. Once present in South Asia, populations may have followed a number of routes, which included both coastal and terrestrial contexts. Yet, Korisettar places considerable doubt on coastal hypotheses for human movements along the continental shelf. Korisettar points out that archaeological evidence for exploitation of littoral contexts is so far absent in the subcontinent. Instead, Korisettar argues that dispersals would have been transcontinental, as supported by the presence of archaeological sites in many inland basins. As indicated elsewhere in this book, regardless of the precise routes undertaken by modern humans, geographic factors would have favored local adaptations over movements, as populations would have encountered barriers and zones with high resource diversity.

The recently hypothesized spread of modern humans to the subcontinent before 50,000 years ago has important demographic and cultural implications. If an early entry date in the subcontinent is valid, anatomically modern humans would have likely been spreading with Middle Paleolithic technology and meeting indigenous populations with similar technologies. The use of Middle Paleolithic technology by both modern and archaic populations in South Asia is analogous to the situation in West Asia, where Mousterian tools were used by Homo *sapiens* and Neanderthals. Modern humans were, predominantly late

major population Pleistocene replacement of course, the only populations to survive in South Asia, though much is to be learned about the degree to which the two populations interacted and whether archaic populations were eventually driven to extinction by direct or indirect competition. The Middle Paleolithic of South Asia was followed by increasing technological diversity (i.e., flake, blade, bladelets) in the Late Paleolithic. The initial transition to the Late Paleolithic is gradual and marked by

increasing usage of blades alongside flake core industries, signaling a range of adaptations through time and space by local populations. At 45,000 years ago, intentional site modifications are evidenced, indicating modification of living spaces in open-air and rockshelter contexts. Geometric microliths and beads are found in Late Paleolithic at ca. 30,000 years ago, indicating the introduction of sophisticated hafting technologies and explicit forms of symbolism.

Finally, a general note of human migrations. Although we use the term "migration," of early humans to denote their dispersal over the face of the earth, these journeys were nothing like the purposeful flight of a bird seeking winter grounds. Rather, ancient hunting, gathering, and scavenging peoples presumably ventured into new territories as they searched for new resources or were made to move by climatic compulsions. The term ‘dispersal’ may also imply some long distance forays of human bands into unknown territories and making these lands their home. This may be a factual position in some cases but not always, even when viewed on generational scale. The dispersal and spread of humans was a slow but steady process whereby humans slowly ‘diffused’ into new territories, expanding their abode, generation after generation, just like other species have done in the animal world. Also, the dispersal of early humans into new territories were not always successful; there were retreats, backtracking and even extinctions.

III.2. Human Dispersal - A Multiregional View

The Stone Age
In the preceding
chapter, we discussed

In the preceding chapter, we discussed at [at] some length thesome length the conventional and well-accepted
Recent African Origin or Replacement model of

well-accepted Recent
modern human's African origins and his dispersal in
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the Old World. The commonly held view of the pro



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history of man that resulted in the emergence of
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commonly held view of the proponents of this model
followed, it is proposed, by a migration of a small
is that there was a speciation event around 150,000
band of modern humans out of Africa and the sub
years ago in the evolutionary history of man that
sequent replacement, with little or no genetic admix
resulted in the emergence of anatomically modern
ture, of all non-African archaic peoples throughout
humans in Africa. This was followed, it is proposed,
the world. Although the routes of movement differ
by a migration of a small band of modern humans
and the timing of the arrival in different regions of
out of Africa and the subsequent replacement, with

the world varies in different versions of the hypothe
little or no genetic admixture, of all non-African archaic
peoples throughout thesis, the basic premise remains the same: physical
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assigning them a

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view received strong support
utilizing a 'genetic clock', i.e., by determining
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cence points in happily migrating and
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failed to entirely support this model. These studies

ceived strong support from genetics during the last
also failed to support any other simple model of
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human demographic history. Added to these difficul
issue has finally been settled. Subsequent data

ties are quite a few points of archaeological and from the nuclear genome, however, failed to entirely anthropological points that simply do not fit in the support this model. These studies also failed to overall picture of the Out-of-Africa hypothesis and support any other simple model of human demothe replacement of the archaics. Some of these difgraphic history. Added to these difficulties are quite
ficulties have been briefly reviewed in the foregoing

two chapters. 176

In this vacuum, several alternative versions, primarily based on Multiregional hypothesis or its different variations, have seen resurgence in recent years. These hypotheses do not depend on the

conventional concept of migration, replacement,

They (the multiregional hypotheses) are based on the basic assumption that human evolution was a continuum in time as well as in space, which means that the modern man may have first evolved in Africa but it did not spread by multiplying within itself, rather by assimilating with the pre-existing hominins in Africa as well as in other continents. **In other words, all the conventional species of the genus *Homo* was one species from the very beginning, differing only in a few superficial, mainly adaptive, features. This super-species evolved collectively and concurrently in Africa as well as in different parts of Eurasia and is now represented by us, the Homo *sapiens sapiens* of different races and regions.**

a few points of archaeological and anthropological points that simply do not fit in the overall picture of
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multiplying within itself as a distinct species, rather primarily based on Multiregional hypothesis or its by assimilating with the pre-existing humans in Afdifferent variations, have seen resurgence in recentrica as well as in other continents. Although differing

in details, these proposals agree on one point:
years. These hypotheses do not depend on the conventional
concept
of
migration,

modern humans, as we encounter them presently,
replacement, may not have originated in Africa alone, they are
and colonization but envision a genetic continuity from Homo
erectus
to Homo
sapiens
instead a product of intermixing, assimilation, inter
or from the breeding, and hybridization with the archaic humans
'archaic' to the 'modern'. They are based on the
inside and outside Africa. In other words, all the
basic assumption that human evolution was a con
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that the modern man may not necessarily have first
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Speaking in technical parlance, the multiregional
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instead a product of intermixing,
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evolved as a single polytypic species united by a worldwide pattern of gene
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coalescence of a series of modern traits that appeared independently in various areas at different times” (136). Few scientists still hold a banner for a strict interpretation of multiregionalism

species evolved collectively and
but modified versions are common,
concurrently in Africa as well as
mostly as attempts toin different parts of Eurasia andpinpoint whether Homo *sapiens* bear genetic
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the multiregional model proposes by Smith
(146,147), accepts an African origin for modern hu
that modern humans evolved from regional popula
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initiated their transition to anatomical modernity. pattern of gene flow and migration.The standard However, few of the hybrid fossils expected in this version of the model asserts that “modern humans scenario have been found outside Africa, and this

has led to some doubt regarding the model (150). Similarly, Relethford (221-224), a strong critique of the conventional wisdom and a supporter of multiregionalism, also accepts the birth of modern man in Africa but decries the replacement theory. There

are, of course, several others, such as Bauer, who

originated through the coalescence of a series of modern traits that appeared independently in various areas at different times” (136).

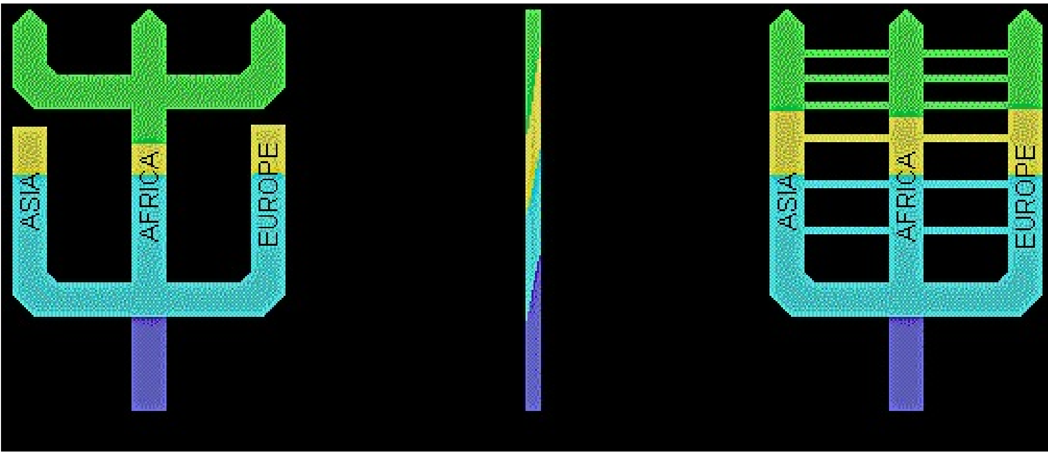
Few scientists still hold a banner for a strict interpretation of multiregionalism but modified versions are common, mostly as attempts to pinpoint whether Homo *sapiens* bear genetic signatures of our encounters with our archaic cousins. For example, the so-called *assimilation* version of the Multiregional evolution



model, proposed by Smith (146,147), accepts an African origin for modern humans but suggests that diffusive gene flow - involving localized population movements, admixture, and selection - spread t h e a d v a n t a g e o u s

genes associated with modern humans to other populations and initiated their transition to anatomical modernity. However, few of the hybrid fossils expected in this scenario have been found outside Africa, and this has led to some doubt regarding the model (150). Similarly, Relethford (221-224), a strong critique of the conventional wisdom and a supporter of multiregionalism, also accepts the birth of modern man in Africa but decries the replacement theory. There are, of also makes the whole discussion on the dispersal of modern humans meaningless: humans evolved as they spread, or they dispersed as they involved. To a large measure, it also renders the definition and chronology for the emergence of ‘modern‘ humans suspect. At what point do we determine that ‘Homo‘ became ‘Human‘ and where? Did not the whole Old World contribute to the evolution of humans, did not humans evolved at different places in different geographic areas? And, did not the ‘modernity‘ manifested itself in different form and intensity at these places and times? These are fundamental differences from the Out-of-Africa and Replacement model that is generally taught in our colleges and universities and, in fact, believed by a majority of our archaeologists and anthropologists. It is clear that once we subscribe to the Multiregional hypothesis, the dispersal of modern humans as a separate topic of discussion evaporates into thin air.

The Multiregional hypothesis, therefore, needs considerably more attention to understand than has been given to it in the foregoing pages. It is especially important when we start discussing the dispersal of modern humans. However, before we delve into this supplementary discussion, we need to take note, even at the risk of some inevitable repetition, of the criticism that has been heaped on the Mitochondrial Eve theory and its corollary in the form of Recent Out of Africa model for the origin and dispersal of modern humans and the Complete



course, several others, such as Bauer, who strongly differ with the Replacement theory but do consider Africa as the ‘birthplace’ of humans. A more rigorous version of Multiregional evolution and dispersal is that of Eswaran. He, like the assimilation theory of Smith, admits the initial spark of modernism originating most likely in Africa. However, he pictures human dispersal as a process of demic diffusion into and limited interbreeding with the preexisting ‘archaic’ or ‘mixed’ populations, selectively propagating some advantageous traits through a series of diffusional waves.

If we subscribe to any of these theories, it not only changes the scenario of human origins but Replacement of the pre-existing archaic humans all over the globe. A lot has been recently written on various aspects of the Multiregional hypothesis (although not as much as that on the Complete Replacement theory). Here we shall take only two examples: one from John Relethford (223) and one from Robert Bednarik (225). We reproduce edited versions of these two articles to give the reader a flavor of the Multiregional criticism on the Out-ofAfrica and Complete Replacement hypothesis and to present a few pertinent points of the debate on which the human dispersal in South Asia essentially hinges as an alternative to the conventional wisdom discussed in the last chapter.

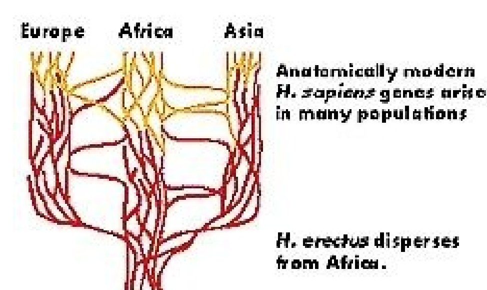
Genetic Evidence and the Modern Human Origins Debate: As stated earlier, the debate on the origin of modern humans is central to the deliberation on their dispersal in Africa and Eurasia., as is evident from the last chapter. The qualifying term ‘anatomically modern’ is used to identify our early ancestors that were physically much the same as living humans, but also to distinguish them from earlier hominins that could be called ‘human’ at some level based on features such as an increased brain size relative to body size and the possession of a material culture (including stone tools). The introduction of the concept of ‘behaviorally‘ modern humans, largely based on European evidence, is another aspect of this debate and is of equal importance.

The fossil record of the past 2 million years shows modern humans evolving from earlier humans, often referred to as ‘archaic humans’, a broad group that includes the species Homo *heidelbergensis* as well as the Neandertals of Europe and Middle Asia. What is less clear is the evolutionary relationship of modern humans to the various archaic human populations, as well as to earlier ancestors. Did modern humans evolve via anagenesis (the evolution of species involving an entire population rather than a branching event)from a single archaic species across the Old World, or did they first arise in Africa? If the latter, then did modern populations expanding out of Africa replace the archaic human populations that lived outside of Africa, or did they interbreed with them? Were the Neanderthals, or other species of archaic humans like the Neanderthals, separate species from modern humans and, if so, did any interbreeding and hybridization take place?

These and other questions fall under what has been termed the ‘modern human origins debate’ and is closely related to the debate on the dispersal of humans in the continents. Although this debate is often focused on the fossil and archeological records, studies of genetic variation have become increasingly important as a source of insight. Much of the work in this area has consisted of detailed analyses of patterns of genetic variation in living human populations. The strategy here is based on the realization that whatever our species’ evolutionary past, it has left visible signatures on our genome. Expectations of current genetic variation under different evolutionary scenarios are compared with observed genetic variation in our species in order to test various origin models. In addition, the research in the last three decades has also seen an increase in the analysis of ancient DNA, and mitochondrial and nuclear DNA sequences are now available for the Neandertals, an archaic human group. Relethford (223) has highlighted some of the major findings of these genetic analyses and their use (and misuse) in the modern human origins debate. Here we focus primarily on most recent findings and the status of the debate as he perceives it.

The fossil record of evolution in the genus Homo: In order to understand the contributions of genetic research to the modern human origins debate, it is first necessary to provide a brief review of the fossil record for human evolution over the past 2 million years ago. This topic has already been discussed in Section II and therefore only a brief review is given here.

Molecularevidencesuggeststhatthe hominin and African ape lines diverged about 6–7 million years ago. The fossil record of the first possible bipeds dates back over 6 million years ago in Africa. By 4.2 million years ago, there is definite evidence of bipedal hominins in Africa. These early hominins walked upright (at least on the ground), had ape-sized brains and larger protruding faces and teeth. The species Homo *erectus* appeared in Africa 1.8 million years ago and is characterized by modern limb proportions, increased brain size, reduction in the size of the teeth and developments in stone tool technology. Until this point in time, hominin evolution had taken place exclusively in



Africa, but populations of Homo *erectus* dispersed to Eurosia about 1.7 million years ago. Some anthropologists refer to the initial African population as the species Homo *ergaster* and reserve the name Homo *erectus* for the Southeast Asian populations. Additionally, on the basis of evidence from Demanisi, georgia, and that from Riwat in Pakistan, some anthropologists identify a more primitive hominid, such as the Homo *habilis*, as the first migrant from Africa, prior to 1.7 million years ago. Anyway, some populations of Southeast Asian Homo *erectus* may have survived until 27,000–54 000 years ago, and perhaps are related to the newly named dwarf species Homo *floresiensis* (although others consider the type specimen to be a pathological modern human).

The descendants of Homo ergaster/Homo *erectus* have often been referred to broadly as archaic humans, a label that bridges the gap between early humans (H. ergaster/ H. erectus) and modern humans (H. sapiens sapiens). The archaic humans have, on average, a brain size approaching that of modern humans, but with a lower and differently shaped skull and larger face and brow ridges

compared with modern humans. Although it had been common for some time to refer to the archaics as archaic Homo *sapiens*, there is growing sentiment to classify these forms into two (or more) species. A number of these specimens are classified as Homo *heidelbergensis*, a species that lived in parts of Africa, Europe and possibly Asia from about 800,000 to 200 000 years ago. A somewhat different archaic form, the Neandertals, lived in Europe and the Middle East from about 130,000–28,000 years ago, and has a number of unique craniofacial traits that distinguish them from Homo *heidelbergensis* and Homo *sapiens*. Classification of the Neandertals has always been a contentious issue, with some anthropologists proposing that they should be classified as a subspecies of Homo *sapiens* (Homo *sapiens neanderthalensis*) and others arguing that they be considered a separate species (Homo *neanderthalensis*).

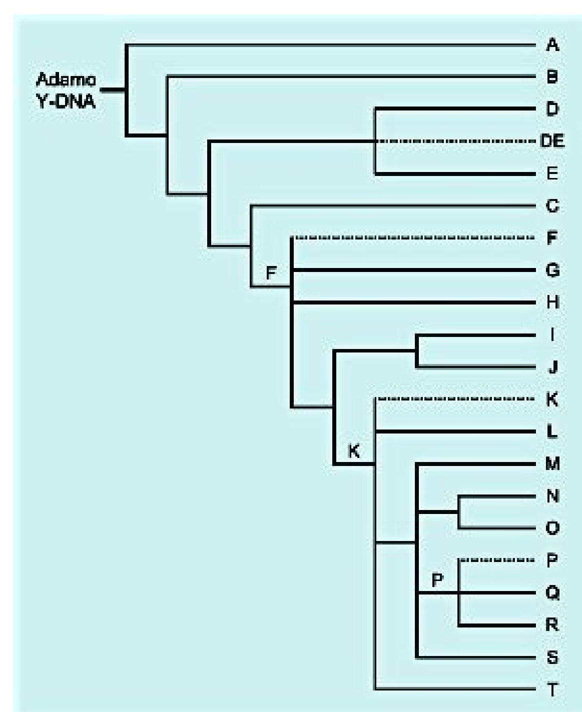
Models of modern human origins: The core question in the modern human origins debate is what is the evolutionary relationship between archaic and modern humans? It has been common to read many articles and books that describe the debate in terms of two opposing camps — the ‘out of Africa’ model and the multiregional evolution model. As stated earlier, in reality, this dichotomy is a bit of an oversimplification, because there is overlap between some variants of these models, and the two models are often misrepresented. Adding to possible confusion is the fact that there are two separate but related questions regarding modern human origins. The first of these questions concerns the time and place of the transition from archaic to modern humans. Did modern human anatomy emerge first in Africa followed by dispersal across the rest of the Old World, or did modern humans instead emerge because of the mixing of different evolutionary changes taking place in different parts of the Old World? The second question concerns the evolutionary relationship between archaic and modern forms. Were they separate species that arose through cladogenesis with little if any hybridization, or were they part of a single evolutionary lineage (anagenesis)? A variety of models, some only subtly different from others, have been generated through different answers to these questions. Some models share answers to one question, but differ on the other. Consequently, there is often disagreement over what models are supported by fossil and genetic observations. Thus, it is useful to examine briefly a few of the basic models.

The African replacement model is one form of what is referred to in general terms as an Out of Africa model. According to the African Replacement model, anatomically modern humans arose as a new species (Homo *sapiens*) inA f r i c a b e t w e e n 150,000 and200,000 years ago. By 100 000 years ago or so, populations of this new species began expanding throughout the Old World, replacing preexisting archaic human species outside of Africa (such as the Neandertals of Europe). Under this model, there was virtually no genetic input from these archaic populations. All living humans thus can trace all of their ancestry 200,000 years ago to Africa.

The multiregional evolution model presents a different explanation for the origin of modern humans. The Multiregional model was first developed to explain how some traits, such as increased cranial capacity and reduction of the face, could evolve across the Old World while at the same time other traits could retain regional distinctiveness over time, such as the high prevalence of shovel-shaped incisors in past and present Asian populations. The seeming conflict between similarity between populations and regional continuity over time was explained by a balance of gene flow, selection and genetic drift (222, 226). According to some proponents of the multiregional model, there was no single time or place associated with the origin of modern humans. Indeed, some have argued that the distinction between archaics and moderns is arbitrary and difficult to define. Instead, this view of multiregional evolution posits that the anatomic and genetic changes leading to modern humans took

place piecemeal across the Old World, and modern humans eventually resulted from the regional coalescence of these changes because of gene flow between populations. All of these changes took place within a single evolutionary lineage. Contrary to some representations of the multiregional model, it does not claim that the appearance of modern humans was due to independent or parallel evolution in different parts of the Old World.

Although the modern human origins debate is frequently discussed in terms of the more extreme views regarding Out of Africa and Multiregional models described above, in reality a number of anthropologists have argued for models that combine an initial African origin of modern humans with varying degrees of gene flow taking place between modern humans dispersing out of Africa and preexisting human populations outside of Africa. In Chapter II.4 we have labeled such models '*Mostly Outof-Africa Models*', characterized by the hypothesis that modern human anatomy did emerge first in Africa (in common with the African replacement model), but that there was some degree of genetic mixture with preexisting archaic populations outside of Africa (in common with the multiregional model). One example of a primary African origin model is Smith's 'assimilation model', a variant of the multiregional model that allows for an initial African origin (147).



Gene trees: The introduction to molecular genetics in the service of human history has been discussed in Chapter IV.1. The rapid development of molecular genetics and the emergence of coalescent theory in population genetics have provided valuable tools for the construction and analysis of genetic genealogies known as gene/haplotype trees. Coalescent theory makes use of the fact that genetic drift over time will result in the extinction of lineages, which in turn means that when looking backward from the present-day generation, any sample of DNA markers will coalesce to a common ancestor. The application of analytic methods based on coalescent theory means that, given a sample of genetic markers, it is possible to identify characteristics regarding that sample's most recent common ancestor (MRCA), specifically the time back to the MRCA and the geographic place that the MRCA lived. If the sample of individuals includes adequate representation from across all of humanity, then these inferences tell us about the MRCA of our species. It is important to keep in mind that such methods work back only as far as the MRCA. Because of the coalescent process, all genetic variation coalesces to the MRCA and thus no information is available for population history before this

individual (227) .

Early work on gene trees focused on mitochondrial DNA (mtDNA), inherited strictly from one's mother. The maternal haploid inheritance of mtDNA means that recombination is not a problem and one can reconstruct the gene tree. The pioneering application to the modern human origins debate was analysis of mtDNA by Cann et al. (48), where they found evidence that the MRCA lived in Africa roughly 200,000 years ago. The idea of a common female ancestor of humanity led, perhaps inevitably, to this ancestor being given the name 'Eve'. Although there were some methodological concerns with their analyses, later analyses confirmed the recent African origin of humanity's most recent common mitochondrial ancestor.

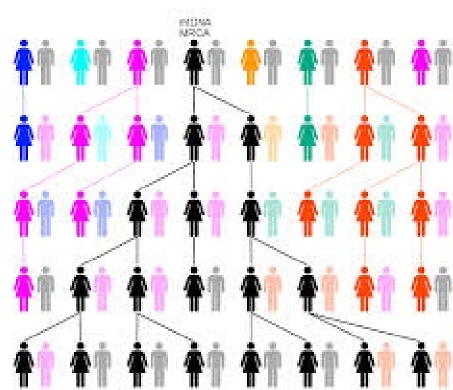
Boththelocation(Africa)andthedate (200,000 years ago) of our common mtDNA ancestor have been argued as support for the African replacement model of modern human origins. The date was considered too recent to be compatible with the Multiregional model, which argued for a common ancestor dating back to Africa close to 2 million years ago. Although the observation of a recent mtDNA ancestor is certainly compatible with the African replacement model, compatibility does not automatically imply proof (49,222). Compatibility with a given model only constitutes proof of a model when the observed data are incompatible with all other models. In this regard, it is important to keep in mind that any gene tree tells us only about the MRCA for that particular DNA marker. Different DNA markers will have different MRCAs, a reason why the ancestral female detected from the mitochondrial analyses is often referred to by the qualifying name 'mitochondrial Eve'. She tells us about our common mitochondrial ancestor, and nothing about other parts of our genome. Because of difference in mutation rates and genetic drift, different DNA markers may have different evolutionary histories. As such, evolutionary inferences based on one DNA marker do not necessarily apply to others, and multiple loci must be examined in order to begin to build a picture of a population's history (227). In addition, potential problems such as recurrent mutation make an exclusive focus on mtDNA alone problematic. More loci are needed.

In addition to mtDNA, gene trees have now been constructed using Y-chromosome DNA (thus sampling paternal ancestry) and a number of nuclear autosomal DNA regions that show little or no recombination. The results vary, with some showing recent African ancestry and some showing more ancient African ancestry. Most, but not all, gene trees show an African root (228). In recent years, more effort has been made to look at the question of modern human origins using multiple-locus comparisons. The most comprehensive of these analyses has been performed by Templeton (227,228) who examined 25 DNA regions: mtDNA, Y chromosome DNA, 11 X-linked markers and 12 autosomal markers using a 6 million years-old date for the human–chimpanzee divergence for calibration. Using a method known as nested-clade phylogeographic analysis, Templeton found that 15 of these markers showed evidence of geographic expansion. The estimated ages of range expansion vary significantly across these markers and do not fit a model of a single expansion, but instead cluster into three groups: (1) an expansion out of Africa 1.9 million years ago, (2) an expansion out of Africa 650,000 years ago and (3) an expansion out of Africa 130,000 years ago .

The three out-of-Africa expansions detected in Templeton's multilocus analysis correlate temporally in an interesting way with the fossil record (230). The earliest range expansion corresponds to the initial appearance and dispersal out of Africa of Homo *erectus*. The second range expansion corresponds to a rapid increase in cranial capacity that took place about 700,000 years ago and overlaps with the appearance of Homo *heidelbergensis*. The third and most recent out-of-Africa

expansion corresponds to dates suggested for the dispersal of anatomically modern humans. Given the large confidence intervals typical of coalescent analysis, this correspondence should, however, be taken as suggestive and not conclusive.

The genetic evidence for three out-of-Africa expansions, each possibly associated with events in the fossil record corresponding to the appearance of a new species, might be taken as support for a broader picture of speciation within the genus Homo, of which the origin of anatomically modern humans is but the latest speciation event. However, although the most recent expansion (169, 000 years ago) is similar to those often reported in the literature in support of an African replacement model, Templeton argues that the genetic evidence of earlier expansions rejects the hypothesis of a total replacement. Gene trees based on living humans will only pick up evidence from the ancestors of living humans, and if we are all descended from a single recent (200,000 years) expansion out of Africa, then there should be no evidence of any earlier expansions. In other words, speciation and complete replacement should erase any genetic evidence for earlier speciation (227,228). If confirmed, evidence of multiple expansions might point to a model of human evolution where the transition between one paleospecies and the next occurred through anagenesis. The first expansion, associated with Homo *erectus*, established hominins outside of Africa for the first time. Subsequent expansions may have involved some level of gene flow between new populations and preexisting non-African populations. Of course, the level of gene flow is likely to have varied from time to time and from place to place, and it seems likely that some populations were replaced, but unlikely that this occurred to all populations.



Regional Differences in Genetic Diversity: Not all living human populations show the same average level of genetic variability, and these differences in present-day diversity can provide us with inferences about our evolutionary history. DNA markers typically

show higher levels of genetic diversity (heterozygosity and nucleotide diversity) in sub-Saharan African populations. This observation has been made for mtDNA , nuclear microsatellite DNA and Alu insertion markers. The same observation has been made on measures of variation from phenotypic traits; within- group variances are highest in subSaharan African populations for both craniometric measures and skin color.

Why would one geographic region consistently show higher levels of genetic and phenotypic diversity? One possibility is greater time depth for the accumulation of mutations. The longer a population has been in existence, the greater the number of mutations that will accumulate. Under an African origin model, mutations would accumulate longer in Africa, as any populations dispersing out of Africa would likely be small, and the subsequent founder effect would effectively 'reset' the accumulation of mutations in the non-African populations. Thus, a model of an initial African origin

followed by dispersals out of Africa at a later point in time would generate the regional differences in genetic and phenotypic diversity that we see today. If correct, the observation of higher African diversity supports the other genetic (and fossil) evidence for an African origin for modern humans, but does not distinguish between an African origin with replacement and an African origin with admixture outside of Africa except to say that if there was any admixture it was not of sufficient magnitude to erase the genetic signature of an African origin.

Furthermore, the fact that the model of accumulated mutations is compatible with the observed genetic data does not mean that it is correct if there are other reasonable interpretations that are also compatible. In the case of genetic diversity, another possible explanation is regional differences in population size, because expected diversity is proportionally related to effective population size. Smaller populations experience more genetic drift and are therefore lower levels of diversity. If the long-term effective population size of Africa were larger throughout most of recent human evolution, then diversity would be greater in Africa than elsewhere, again consistent with the observations of present-day variation. Analyses of craniometric data and microsatellite DNA support this hypothesis (49). A larger African population is also consistent with archeological and ecological inferences (222). If higher levels of genetic diversity in sub-Saharan Africa are due to a larger long-term effective population size, then the observation of higher diversity does not provide any resolution about the modern human origins debate. All of the models proposed to date can easily accommodate a larger African population. In this case, genetic data may be telling us more about the demographic, rather than phylogenetic, history of our species.
A Cline in Genetic Diversity: Inferences about modern human origins can also be made from the observation that in addition to subSaharan Africa having the highest levels of genetic diversity, there is also a geographic pattern in regional diversity. Specifically, genetic diversity outside of Africa tends to be a subset of the diversity within Africa. In addition, global analyses of microsatellite DNA markers and craniometric traits have shown clear patterns of genetic and phenotypic diversity decreasing as the distance from East Africa increases.

This geographic cline in diversity is consistent with an African origin and subsequent dispersal of modern humans out of Africa. The nature of this dispersal is still being debated. For example, Ramachandran et al. (231) argue that the diversity cline is consistent with a model of serial founding effects out of Africa, whereas Liu et al. (167) suggest that a model of colonization events with gene flow is more appropriate. Further work also needs to consider the suggestion discussed above for larger African population sizes and, more generally, alternative demographic scenarios that might apply. It is possible that a number of different models can all fit the diversity cline equally well. Furthermore, the fundamental issue of the fate of archaic populations outside of Africa remains. At present, the diversity cline might reflect a genetic signature of an expansion out of Africa, but in Relethford's view does not resolve the debate over replacement versus assimilation. Although many analyses have used the diversity cline in support of a replacement model, Eswaran et al. (151) have provided an expansion model that incorporates assimilation from archaic populations.
The Estimated number of human ancestors: The relationship between genetic diversity and population size has meant that it is possible to estimate the effective population size of a species. When applied to data from living human populations, such estimates typically suggest a long-term average of 10,000 individuals of reproductive age (222). Because long-term population size reflects a harmonic mean over time, this figure further suggests that humans have recently expanded from a relatively small number of ancestors, a view that fit with many conceptions of an African replacement model. The reasoning here is that such a small number of individuals could not have been spread out throughout

the Old World and still be connected via gene flow, making any sort of multiregional evolution unlikely. A small species effective size is thus considered more likely explained in terms of an expansion from a small initial population in Africa. The situation is not that simple, however, as the genetic estimates of population size are effective population sizes that can differ greatly from actual census size and the latter is not a proxy for the former. Effective size can be considerably less than census size. Eller et al. (232) show that a model of extinction and recolonization of local populations with reasonable parameters could result in a long-term census size of several hundred thousand individuals and still produce an effective population size of about 10,000. In another example, Eswaran et al. (151) have shown how a wave-of-advance model could also explain low estimates of effective species size even given a larger census size. Of course, the compatibility of a model and data does not necessarily prove the model, but it does show that the initial view of the small species effective size supporting an African replacement is also not necessarily correct.



AncientDNAand the Fate of the Neanderthals: The debate over replacement versus assimilation is nowhere more intense than in continuing discussions of the evolutionary status and ultimate fate of the Neandertals. Questions regarding whether Neandertals should be considered a subspecies of Homo sapiens or a separate species ultimately boil down to the question of how much of our ancestry derives from them. Even if they were a biologically separate species, the question of possible genetic ancestry remains because modern humans and Neandertals could have been allotaxa that could hybridize (333). What genetic evidence exists for some potential Neandertal ancestry in modern humans?

Although the question of Neandertal ancestry has long been addressed using the fossil record, the past decade has also seen the rapid development of Neandertal genomics as methods of ancient DNA analysis have been applied to Neandertal fossils. The first example of this approach was the pioneering work of Krings et al. extracting a 378-bp sequence of mtDNA from the original Neandertal specimen. Subsequent analyses of ancient DNA have shown that the results from this study were not a fluke, and short mtDNA sequences have now been extracted from 11 other European

Neandertal fossils. As a group, the Neandertal mtDNA sequences are more similar to each other than to living humans. Although it was thought initially that Neandertal mtDNA exhibited relatively low levels of variation, the accumulation of more specimens suggests their mtDNA diversity might have been greater.

The differences between Neandertal and living human mtDNA have often been interpreted as support for the view that Neandertals were a separate species that diverged about half a million years ago. This conclusion has not been universally accepted. Although the number of sequence differences between Neandertals and living humans is greater than found among living humans today, this difference is still within the range seen between chimpanzee subspecies, consistent with the view of some that Neandertals were a separate sub- species rather than a separate species.

Regional comparisons of mtDNA have also been used to support the claim that Neandertals were a separate species with little if any hybridization. It has been argued that if there was a genetic contribution of European Neandertals to living Europeans, then the mtDNA of Neandertals should be more similar to mtDNA from living Europeans than to mtDNA from living humans in other geographic regions. Instead, Neandertal mtDNA is genetically equidistant from living humans across the world, an observation taken as evidence that Neandertals were a separate species (234). The accuracy of the underlying assumption of this argument, however, depends on rates of gene flow and the age of the Neandertal specimens, and it is possible for Neandertals to have contributed more genetically to living Europeans, but over time this regional difference could have diminished because of interregional gene flow (235).

The major finding from Neandertal mtDNA that supports the hypothesis that the Neandertals were not part of our ancestry is the fact that no Neandertal mtDNA sequences have been found among living humans. In addition, studies to date of ancient DNA from anatomically modern humans show genetic differences from Neandertal mtDNA . This noticeable genetic difference can be explained in two ways. First, it is possible that there are no surviving Neandertal mtDNA sequences in our species because the Neandertals became extinct and did not contribute to our ancestry. A second possibility is that the Neandertals were part of our ancestry but their specific mitochondrial haplotypes were lost over time due to genetic drift. The question of Neandertal ancestry has now become a question of the probability of haplotype survival, and as such is dependent on the parameters used to determine these probabilities, including population sizes, rates of gene flow and duration of contact between Neandertals and modern humans in Europe. Studies to date have suggested that the total possible amount of Neandertal ancestry for living humans was not very large, but it has not yet been possible to distinguish between a model of some limited Neandertal ancestry and a model of no Neandertal ancestry.

The evidence from ancient DNA, both mitochondrial and nuclear, must be considered alongside the fossil evidence regarding the fate of the Neandertals. As a group, the Neandertals are extinct and have been perhaps as long as 28,000 years. The real question is the nature of their disappearance. Although the idea of replacement by modern humans, presumably better adapted biologically and/or culturally, has been a popular conclusion, closer examination of the fossil evidence, combined with genetic analysis, suggests that the situation may not be that straight forward. The earliest modern humans in Europe show the presence (though at reduced frequency) of unique Neandertal traits, a pattern that is not expected under a model of complete replacement (233). These traits become less common over time, and are often absent in living Europeans, suggesting that over time the Neandertals become

extinct through ‘swamping’ genetically of larger population of modern humans moving into Europe. Under this model, the Neandertal gene pool was assimilated rather than replaced. Therefore, the overall ancestral contribution of Neandertals to living modern humans may be very small, a suggestion consistent with analyses of both mtDNA, as well as patterns of linkage disequilibrium in living humans. A continuing challenge is to develop methods capable of distinguishing between a model of very low Neandertal ancestry and a model of no Neandertal ancestry.

Adaptive genetic introgression: One of the newer expansions of the modern synthetic theory of evolution is the idea that the genetic variation can arise not just through mutations within a species, but also through hybridization with species. Hybridization between different usually yields maladaptive offspring, but occasionally a fertile hybrid can be the source of a new gene that can spread through a species that didn’t originally have it. Genetic introgression occurs when an allele is introduced from one group (a species or subspecies, for example) into another at a low initial frequency. Introgression can have a significant impact if the newly introduced allele is favored through natural selection.

Traditionally, hybridization and introgression have been considered unimportant in the evolution of animal species. The lack of interest in introgression mainly stems from the observation that interspecific hybrids often display reduced fitness or sterility, an observation that can be extended to plants as well. At first glance, if F1 hybrids fail to thrive then genetic exchanges appear questionable. But even though reduced hybrid fitness may tend to limit gene flow between populations, it does not another

species prevent relatively high levels of adaptive introgression . This is because any allele introduced recurrently into a population will succeed or fail based on the strength of selection upon it. This insight and molecular assays of multiple genes have caused a resurgence of interest in hybridization and introgression in mammals. For example, a survey of 13 X-linked loci found evidence for adaptive introgression across a hybrid zone between Mus domesticus and Mus musculus.

Hawks and Cochran (236)) reviewed examples of such adaptive introgression in plants and animals and make the case that the genetic introgression of ‘archaic’ alleles into the gene pool of an expanding modern human population can explain why some analyses (both on fossils and genetic data) show evidence of ancient mixture and others do not. It is possible that an expanding modern human population demographically and genetically ‘swamped’ the contributions from archaic populations outside of Africa for the most part, but some alleles persisted because of natural selection. Hawks and Cochran (236) argue that adaptive introgression might have had a major impact on the evolution of modern humans, and outline some possible avenues for future research to test this hypothesis.

The “Mythical Moderns” (225**):** Fundamental to any consideration of the evolution of human cognition, symbolism and many other related developments is the time frame in which it may have occurred. But while there is reasonable consensus, at least in the very broadest terms, on the physical, especially skeletal, evolution of hominins, when we come to their non-physical development the disagreements could hardly be greater. Essentially, there are two schools of thought, described as the short-range and long-range theories, sometimes called the ‘discontinuist’ and the ‘gradualist’ models (237). These two diametrically opposed conceptions perceive two entirely different paths of non-physical human evolution. The short-range model rejects all evidence of symbol use prior to about

40,000 years ago, insisting that it commenced as part of the claimed cognitive revolution with the advent of the Upper Paleolithic (see Chapter VI.4). This model coincides with the various ‘Out of Africa’ hypotheses, such as the ‘African Eve’ complete replacement scenario (238), the ‘Afro-European sapiens’ model (239), the ‘wave theory’ (150,151,152) and the ‘assimilation theory’ (233). The Eve model regards ‘Neanderthals’ and ‘Moderns’ as separate species, unable to interbreed, whereas the more moderate varieties accept the occurrence of mixing and therefore are merely variations of the multiregional theory (222,223), claiming a strong inflow of African genes. All models of a reticular gene flow are in fundamental agreement with Weidenreich’s original trellis diagram (240), discussed in Chapter II.4. Nevertheless, what unites all these models is that they assume a quantum jump in cognitive evolution in Europe at the time of the arrival of these ‘mythical Moderns’ from Africa.

The long-range model, by contrast, perceives a gradual evolution of language, art-like productions, advanced hunting methods, shelter building, garment making, interment, social complexity, and of course the symbol use which, it is thought, drove most of these developments forward. This gradual evolution occurred over vast time spans well before 40,000 years ago, and some of it was already underway well before a million years ago. The evidence for the long-range model consists of a panoply of material finds which the short-range protagonists seem unfamiliar with. When confronted by individual finds challenging their model they try to explain them away; or regard them as a ‘running ahead of time’; or pronounce them untypical; or challenge their dating or the scholarly competence of their presenters. This is a familiar pattern in Pleistocene archaeology, dating back to the times of Boucher de Perthes and Penally (Chapter II.1).

Irrespective of which model is right, we have to note that there is currently no consensus about which time frame we need to look at if we wish to consider against background, or what course it might have taken. There are no intermediate possibilities, because the two models are incapable of accepting compromise and are mutually exclusive.

A review of the short-range model — its basis and underlying assumptions in the light of recent developments has been the basis of the discussion so far, where the Replacement Model has been assumed although not explicitly brought into discussion. Although this hypothesis is incapable of explaining the situation in South Asia and beyond, this model derives its main support from genetics. Its key assumption is that the ancestors of all extant humans conquered the world during the Late Pleistocene, being genetically, technologically, cognitively, culturally and intellectually superior to all of their contemporaries of the period preceding their Exodus from Africa. In the process they annihilated or out-competed all their contemporaries (ecologically or by introducing new diseases) in all parts of the world then settled. In the ‘African Eve’ version, all humans from about 27,000 years ago (or about 50,000 years onwards) are descended from them exclusively. Because these ‘anatomically modern’ ancestors of ours were a separate species, unable to breed with other hominins, all extant human populations must originate from a small, isolated population in some unspecified region of subSaharan Africa.

According to critics, this ‘African Eve’ or ‘replacement’ hypothesis does not resemble a realistic model of phylogenetic evolution or demographic population dynamics. The paradigm is not based on an unrefuted proposition of scientific status, but on controversial contentions of some geneticists (opposed by others), and there is little archaeological when cognitive evolution occurred, or

what kind of cultural and technological evidence in its favor. Even the genetic justification of this model is fundamentally flawed, for several reasons. Different research teams have produced different genetic distances in nuclear DNA, i.e. the distances created by allele frequencies that differ between populations. Some geneticists concede that the model rests on untested assumptions; others even oppose it (241,242). The various genetic hypotheses about the origins of 'Moderns' that have appeared over the past few decades place the hypothetical split between Moderns and other humans at times ranging from 17,000 to 889,000 years ago. They all depend upon preferred models of human demography, for which no sound data at all are available. This applies to the contentions concerning mitochondrial DNA (African Eve) as much as to those citing Y-chromosomes (243). The divergence times projected from the diversity found in nuclear DNA, mtDNA, and DNA on the non-recombining part of the Y chromosome differ so much that a time regression of any type is extremely problematic. Contamination of mtDNA with paternal DNA has been demonstrated, and Kidd et al. (244) have shown that, outside Africa, the elements of which haplotypes are composed largely remain linked in a limited set.

The genetic picture in Africa as well as elsewhere has been found to be far more complicated than the Eve proponents ever envisaged. The much-promoted claims that Neanderthals were genetically different from modern Europeans, based on very fragmentary DNA sequences, were erroneous, as Gutierrez et al. (245)) have shown. Pruvost et al. (246) have recently shown that DNA deteriorates rapidly after excavation, up to 50 times as fast as in buried specimens. The various reported 'fragmentary DNA sequences' from 'Neanderthal' remains stored for up to 150 years need to be considered in that light. A large part, on average 85%, of the genetic material preserved in fossils is lost as a result of treatment by archaeologists and storage in museums, therefore the results disseminated from these specimens and their interpretations may be questioned. More reliable are genetic studies of living populations, which have shown that both Europeans and Africans have retained significant alleles from multiple robust populations (227).

Relethford (247) has detected drastic spatiotemporal changes in the genetic profiles of three recent Chinese populations, negating the idea of regional genetic homogeneity. He found that the Linzi population of 2,500 years ago is genetically more similar to present-day Europeans than to present-day eastern Asians. This refutes the idea that regional comparisons of DNA can establish affinity or its absence. Assumptions about a neutral mutation rate and a constant effective population size are completely unwarranted, and yet these variables determine the outcomes of all the genetic calculations. For instance, if the same divergence rate as one such model assumes (2–4% base substitutions per million years) is applied to the humanchimpanzee genetic distance, it yields a divergence point of 2.1–2.7 million years, which can be considered unambiguously false. Nei (248) suggests a much slower rate, 0.71% per million years, according to which the human-chimpanzee separation would have occurred 6.6 million years ago, which is close to the estimate from nuclear DNA hybridization data of 6.3 million years. It also appears to be close to what the fossil record seems to indicate. However, this would produce a divergence of 'Moderns' at 850,000 years ago, over four times as long ago as the favored models, and eight times as long ago as the earliest fossils of purported Moderns ever found (though both their dating and modernity are controversial).

When the same 'genetic clock' used in all this is applied to dogs and suggests that the split between wolves and dogs occurred 135,000 years ago, archaeologists reject it on the basis that there is no paleontological evidence for dogs prior to about 14,000 years ago. In other words, the weak theory that provides the only basis for the replacement scenario is rejected when applied to another species.

The scenario of genetic isolation, long enough to render Eve's progeny unable to interbreed with any other humans, is another unsupportable short-range notion. Interbreeding yielding fertile offspring occurs between many species (e.g. in wolf, coyote and dog; in several species of deer; in mallards and ducks).

In combining the model of a population bottleneck with that of an endemic population we also need to remember that genetic bottlenecks tend to reduce fitness in the population rather than bring about the population's supremacy, so how did Eve's progeny attain their 'superior' qualities? Another genetic model has modern humans evolving from two discrete populations, one resulting in modern Africans, the other in non-Africans. Templeton (90) contradicted the replacement hypothesis genetically. Using 10 different haplotype trees (MtDNA, Ychromosomal DNA, two X-linked regions and six autosomal regions), he showed that following an initial exodus from Africa at about 1.7 million years ago, there were at least two subsequent major expansions out of Africa. One occurred at 840– 420,000 years ago, the second at 150,000–80,000 years ago. The genetic data also show ubiquity of genetic interchange or interbreeding between human populations throughout the 1.7 million years.

It is also of concern that the first colonization dates assumed by the geneticists supporting the Eve model are mostly false (48), and these researchers admitted from the beginning of their involvement that their base-pair substitution rates were based on the (almost certainly false) assumption of single colonization events. It has long been known in Australia, for instance, that there were multiple settlement events, and the same can be assumed in most other cases of colonization. In Australia, the lineage of the earliest known 'anatomically modern' remains, Lake Mungo 3, has been shown to have probably diverged before the most recent common ancestor of contemporary human mitochondrial genomes. In the absence of any reliability of the proposed rates of nucleotide changes and the many variables to be accounted for effectively, the contentions by the replacement advocates are unsupported, and nucleotide recombination renders their views redundant.

Instead of unambiguously showing that anatomically modern humans originate in one region, sub-Saharan Africa, all the available genetic data suggest that gene flow occurred in Old World hominins throughout much of recent human evolution (20,249), which is also strongly suggested by all available empirical evidence, both paleoanthropological and archaeological. Homo sapiens sapiens seems to have evolved as a single extended breeding unit across much or most of the region then occupied by robust sapiens hominins, from southern Africa to eastern Asia and Australia. Extensive genetic drift, introgression and episodic genetic isolation rather than mass migration probably account for the mosaic of hominin forms through time.

The Fossils: The African Eve model derived initially from the Afro-European sapiens model of Gunter Brauer's work, which relied on the datings of Professor Reiner Protsch von Zieten. Following his forced resignation from the University of Frankfurt, it has become clear that all of Protsch's dates for German human remains were spectacularly false, and that the replacement advocates had been the subjects of a hoax for several decades. If they had not relied on the claimed ages of the German fossils, it is unlikely that the model would have been launched quite so enthusiastically, if at all. The recent rejection of the Upper Paleolithic age of nearly all German human remains formerly attributed to that period has certainly great consequences for all versions of the African Moderns model.

The replacement model has also heavily depended on the anatomically modern Vogelherd specimens to believe that the people of the Aurignacian, the first Upper Palaeolithic 'culture', were in fact

‘Moderns’. This was particularly precipitate, because anyone who has actually examined the Vogelherd skull will have been struck by its modern appearance, both anatomically and in terms of its preservation. More careful commentators have long warned that ‘judging by its appearance it would fit much better into a late phase of the Neolithic’ (249). Direct carbon isotope determinations, of samples taken from the mandible of Stetten 1, the cranium of Stetten 2, a humerus of Stetten 3 and a vertebra of Stetten 4, all agree, falling between 3,980 ± 35 years ago and 4,995 ± 35 years ago. Contrary to Churchill and Smith (250), Brauer (251) and numerous others, the Stetten specimens tell us therefore absolutely nothing about the skeletal anatomy of the ‘Aurignacians’.

Similarly, the sample from Cro-Magnon in France, traditionally regarded as typical representatives of invading ‘Moderns’ in Europe, has been falsely attributed. Sonneville-Bordes (252) placed the four adults and four juveniles in the late Aurignacian, Movius (253) suggested an age of about 30,000 years ago and preferred an attribution to the Aurignacian 2. The recent re-dating to about 27,760 carbon years ago renders both opinions invalid, and the remains are of the Gravettian, i.e. the ‘culture’ that followed the Aurignacian. Moreover, the frequent reference to the Cro-Magnon remains as the ‘type fossil’ of early ‘modern’ anatomy in Europe requires qualification. Wolpoff has long pointed out that the very pronounced supraorbital torus, projecting occipital bone and other features of cranium 3 are Neanderthaloid rather than gracile. This — along with other aspects of the generally robust Cro-Magnon series — casts doubt on the full modernity of this group, and, besides, tells us nothing about the anatomy of the ‘Aurignacians’.

Similarly tenuous are the identical claims for the Mladecˇ specimens from the Czech Republic. It is uncertain that the cave was even accessible to Upper Paleolithic humans; it is thought that their remains entered the cave via a vertical shaft from above (225). The site was entirely bereft of archaeological strata by the time systematic excavations were developed, and little is known about its archaeology. Recent attempts to provide direct dates from some of the human remains (254) yielded five results ranging from about 26,330 to 31,500 years ago. The fossils are therefore at best from the latest part of the Aurignacian period, but also point to a possible Gravettian age. Moreover, there is considerable evidence that the Mladec humans were far from fully modern. There appears to be pronounced sexual dimorphism, with male crania being very robust. The female specimens show similarities with, as well as differences from, accepted Neanderthal females. The Mladecˇ population thus seems to occupy an intermediate position between late Homo sapiens neanderthalensis and Homo sapiens sapiens, a position it shares with numerous human remains from other Czech sites. The material from the Pavlov Hills is among the most robust available from the European Upper Paleolithic, sharing its age of between 26,000 and 27,000 years ago with yet another Moravian site of the Gravettian, Pˇredmostı.

The Cultures: The record so far mentioned already suffices to significantly discredit the replacement hypothesis, and with it much of the ‘short range’ model, but there is much more still to consider. The record of technologies straddling the contrived division between Middle and Upper Paleolithic technocomplexes is perhaps even more persuasive. Across Europe, from Spain to Russia, the evolution of the European Upper Paleolithic traditions from the preceding Mousterian tradition is evident at literally hundreds of sites. It has been widely purported that the ‘invading Moderns’ (the first in history to be ‘bringing beads to the natives’) entered Europe from the southeast, perhaps through a ‘Danube corridor’ or through the Balkans. However, there is no archaeological indication of any Upper Paleolithic technology spreading from the southeast to western Europe—or, for that matter, from the Levant or anywhere else, supporting the replacement model. Even the Ahmarian is

thought to have developed gradually and in situ, from ‘Middle Paleolithic’ traditions (255).

In parts of Africa, Upper Paleolithic technologies occur tens of thousands of years before their advent in Europe: the microlithic features of the Howieson’s Poort phase, the prismatic blades of the Amudian, and the bone harpoons from Katanda come to mind. In India and Pakistan, the Upper Paleolithic is notoriously hard to pinpoint, while China lacks a distinctive Middle Paleolithic. In Australia, the Middle Paleolithic mode of production continues until well into the Holocene, while the Middle Stone Age of sub-Saharan Africa continues until 20,000 years ago. On the Indonesian island of Flores, a putative separate hominin species supposedly derived from Homo *erectus* or even older stock used ‘Upper Paleolithic’ tool types, while one of the two different Acheulian hominins at Narmada (256) has a brain capacity well above that of moderns.

Nothingseemsquiteaswellorderedin hominin evolution as our neat theories predict it should be. Some of the most challenging evidence comes from Australia. Here, first colonization is universally agreed to have been by modern humans, though with distinct archaic features. The replacement advocates have no choice but to argue that the symbolism revolution they place at the beginning of the Upper Paleolithic must have occurred before this colonization event, perhaps 60–40,000 years ago. But the technology of the Australids is certainly Middle Paleolithic, and often even Lower Paleolithic, and continues to be so until midHolocene times. Once again, the replacement scenario is clearly refuted on the basis of the definitions of its own advocates.

Discussion: The overwhelming impression of the collective evidence from the artifact assemblages of Europe, from the time interval of about 45,000–25,000 years ago, is that there is no evidence of any sudden change of technology as one would expect to find had there been an intrusion of genetically different people with a more developed material culture. Instead, there is a complex mosaic of regional traditions that, in general, exhibit a gradual change of several variables, such as tool size, knapping method, retouch and reuse. In numerous cases, in the continent’s east, south and southwest, the gradual evolution of so-called Upper Paleolithic traditions from Middle Paleolithic ones can be traced at individual sites. This alone negates any ideas of a mass movement of people to account for changes.

Moreover, the notion that different ethnic groups such as robust sapiens people (e.g. ‘Neanderthals’) and gracile sapiens people (‘moderns’) used different technocomplexes is perhaps one of the greatest fallacies of the replacement proponents. Several ‘Upper Palaeolithic’ ‘cultures’ are the work of ‘Neanderthals’, just as ‘Moderns’ used a Middle Paleolithic mode of production, for instance in the Maghreb, Levant, in Spain, Ukraine and Australia. Wherever robust and more gracile forms of humans apparently co-existed, they appear to have shared similar cultures, technologies, even ornaments. Therefore, the idea that one can trace ethnic differences through tool assemblages is unlikely to be helpful. The Aurignacian did not arrive from the Levant - on current evidence it would seem to commence in Catalonia and Cantabria - and other European Upper Paleolithic traditions seem to emerge about the same time in various eastern European centers, such as the Russian Plain, and in Asia.

Similarly, the use of unproven taxonomic technological divides, especially that between Middle and Upper Paleolithic, as reified tools of analysis and definition is as unfortunate as the use of minor skeletal differences, such as those between robust and gracile humans, in inventing movements of populations. Not only is there no evidence of any major population replacing another in Europe

during the period in question, this is again an exercise in trying to make the evidence fit the theory. All of this has long been known and, to some extent, appreciated, but now there is a new possibility: that the Aurignacians, and indeed all people with European Upper Paleolithic traditions, were not 'moderns', but 'Neanderthals'.

In the final analysis the replacement advocates placed all their trust on the unassailability of the concept that the Aurignacian derives from their moderns. They have for decades belabored the cognitive sophistication evidenced by paleoart and beads that could not possibly have anything to do with Neanderthals. If all this wonderful art were the work of Neanderthal descendants, the replacement model would be defeated on all counts: technology, culture, genetics and physical anthropology. So even if the retreating argument were to be now, perhaps the Aurignacians started out as a Neanderthaloid society, but by the time of Chauvet and Vogelherd (32,000 years ago) their culture had become adopted by moderns, that would still negate the integrity of the replacement model. If this 'culture' had been begun by Neanderthals, and then, half-way through, taken over by 'culturally superior invading moderns', why should we assume the latter's 'superiority'? And at what specific point in time did the replacement occur?

The Upper Paleolithic art traditions are a local development in central and south-western and northeastern Europe, they were not introduced from Africa or anywhere else, there are no precedents for the prominently zoomorphic traditions of western Europe. They were initiated by Neanderthals and developed by post-Neanderthals. In most of the world then occupied by humans, art traditions are almost entirely non-iconic in nature — the iconic content of the Upper Paleolithic art in western Europe is an aberration not found elsewhere, with over 99% of the world's Pleistocene paleoart being non-figurative. There is not one iota of archaeological evidence of a movement of Late Stone Age traditions northwards through northern Africa, in fact the Middle Stone Age continues to about 20,000 years ago in that region.

Moreover, we must always remember that we know absolutely nothing about one half of the human Pleistocene population, in Europe or anywhere else. The people who lived on coasts, in deltas or along the lower reaches of major rivers were no doubt more sedentary, had much more reliable food sources, and they would have made up around half the human population. Because of the substantial fluctuations of the sea level throughout the Pleistocene, most traces of them are beyond our reach or have been destroyed. Indeed, the only Pleistocene populations of shores we can know about are those that lived along large lakes that have long ceased to exist. We know of such sites, and what we find at them is that the people of the Lower Paleolithic period already built villages of stone-walled shelters (257). This renders the minimalist explanations of much Pleistocene archaeology inadequate. Not only is our knowledge of the mobile inland hunters limited and skewed by various taphonomic factors, we know nothing about the genetic, cultural and technological status of the - no doubt more developed - coastal tribes, and what they contributed to cultural and physical evolution.

But there is a more parsimonious explanation available for this universal change from robust to gracile humans. If we add to the equation the effect when breeding mate selection becomes increasingly moderated by cultural factors (such as cultural constructs of attractiveness, along with perhaps social position, communication ability, adornment), we have a far more plausible explanation for the worldwide change from robust to gracile types from roughly 40,000 years ago to the present, than the weakly supported replacement hypothesis offers. This is certainly not a development unique to Europe, it is found in Australia, Asia and Africa as well - a key factor that has remained largely

ignored. There is no natural evolutionary explanation for this universal change, it did not involve any increase in brain size or other improvement in evolutionary fitness. In fact, Neanderthals had larger brains than their descendants, modern Europeans. Nor does the cranial gracility of modern humans confer any evolutionary benefit on them, and yet physical anthropologists have uniformly failed to ask the obvious: why did Homo sapiens change to gracile skull architecture and other inferior skeletal and muscular features? In the case of both australopithecines and humans, evolution typically selected in favor of robustness, yet in the second half of the Late Pleistocene, this trend was reversed and neotenous features were strongly selected. It is incumbent upon us to explain why a species should suddenly, in evolutionary terms, develop such regressive features as thinner skulls, significantly reduced bone and muscle strength, and perhaps even hair loss in a cold region. Many other aspects of the marked foetalization in recent hominins need to be explained. Numerous features of humans are shared by foetal or infantile apes: the labia majora and hymen, the absence of a penis bone, the forward-pointing organs of the lower abdomen, lack of hair except on chin and top of head, thin-walled globular skull, absent tori, or the shapes of forehead, hands and feet, to name only some. Nature does not select for such plainly disadvantageous variables, but culture might.

This is where Darwin needs to make room for Mendel. The most logical explanation is that cultural factors had begun to dominate breeding patterns to the extent that modern humans are the outcome of their own, albeit unintended, domestication. The dog, domesticated to even more radical skeletal extremes in just 14,000 years ago, provides a dramatic example of the effects of domestication, but so do numerous other species. Cattle, pigs, cats and so on all experienced reticulate evolution through massive introgression, and Badnarik (225) proposes that humans were no different. We would be hard pressed to deny that cultural determinants had become so powerful in recent human phylogeny that they could have selected in favor of gracility.
logical developments; (ii) a dispersal into regions with lower population density; (iii) a limited admixture with the people encountered in the process.

Theoretical work



Luca Cavalli-Sforza - *Demic Diffusion* of agriculture in Europe

by Luca Cavalli-Sforza showed that, if admixture between expanding people and previously resident groups of hunters and gatherers is not immediate, the process results in the establishment of broad genetic gradients. Because b r o a d g r a d i e n t s spanning much of Europe in the Southeast-Northwest direction were identified in n e t i c Cavalli-Sforza and others, it seems likely

that the spread of agriculture into Europe occurred by the expansion and spread of agriculturists, possibly originating in the Fertile crescent of the Near East region. This is referred to as the Neolithic Demic diffusion model and efforts have been made to apply it to the dispersal of modern humans originating in Africa.

Diffusional Wave Model: Vinayak Eswaran expanded this concept to evolution and dispersal of humans in its broader context. In essence, Eswaran proposed (151,152,153) that human dispersal was essentially a process of gene flow, coupled with some actual movement of breeding people, that was taking place all along the outer edges of a *diffusional front* at varying speeds and directions, which depended on the ecology under which the diffusional front was operating, the resources for the sustenance of the increasing population were available, and whether the physical hurdles to the movement of people were present or absent. Furthermore, the assimilation and expansion occurred in spurts. In this sense, the process of human dispersal can be visualized as a succession of ripples in a pond, emanating from a single or multiple points, each ripple pushing the one ahead of it and in turn being pushed outward by the one that followed. The center or origin of these ripples was, of course, East Africa but, as will be seen later, several subsidiary points of ripple generation arose in terms empirical ges t u d i e s b y

The most parsimonious theory to account for the apparent reduction in evolutionary fitness is that physical appearance became a cultural construct affecting mate choice, beginning with a sexual preference for females with neotenous characteristics (Retention of juvenile characteristics in the adults of a specie). In Europe, it is clear that in the postNeanderthal populations, gracility began as a female feature; the decline of robusticity in males lagged many millennia behind the gracilization of females - as it still does today. Ethnologically, sexual dimorphism is usually related to such behavior as fighting between males, but its rapid and universal disappearance towards the Final Pleistocene suggests not a selection in favor of not fighting, but rather a non-natural factor — a cultural factor: constructs of attractiveness affected mating patterns. Individuals considered attractive had more offspring, and it is they who ‘replaced’ those with robust genes.

Demic Diffusion Model: Demic Diffusion model consists of population (demic) diffusion into and across an area previously uninhabited by that group, possibly, but not necessarily, displacing, replacing, and intermixing with a pre-existing population (e.g. as has been suggested for the spread of agriculture across Neolithic Europe, and what occurred with the European colonization of the Americas). In its original formulation, the demic diffusion model includes three phases, namely: (i) population growth, prompted by newly available resources as in the case of early farmers, and/or other techno


Vinayak Eswaran - *Demic Diffusion* in Human Dispersal

of major mutations and genetic diversification of expanding human populations. These ripples often collided with each other and influenced the genetic contours of the population groups involved. The job of population geneticists is to disentangle these influences, collisions, and mergers, and to figure out the directions of regional population movements in the remote past. It is certainly not an exercise of genealogy, nor is it the sole prerogative of discrete human migrations.



Several subsidiary points of ripple generation can arise in terms of major mutations and genetic diversification of
expanding human populations. These ripples often collide
with each other and influence the direction and speed of propagation of the main diffusional wave. It also affects the genetic contours of the population groups involved. The contours of the wave also depended on the ecology under which the diffusional front is operating, the resources for the sustenance of the increasing population are
available, and whether the physical hurdles to the movement of people were present or absent.



Complex patterns of diffusional waves can result if more than one centers of origins are present and the ensuing waves or ripples colloid with each other. This has most

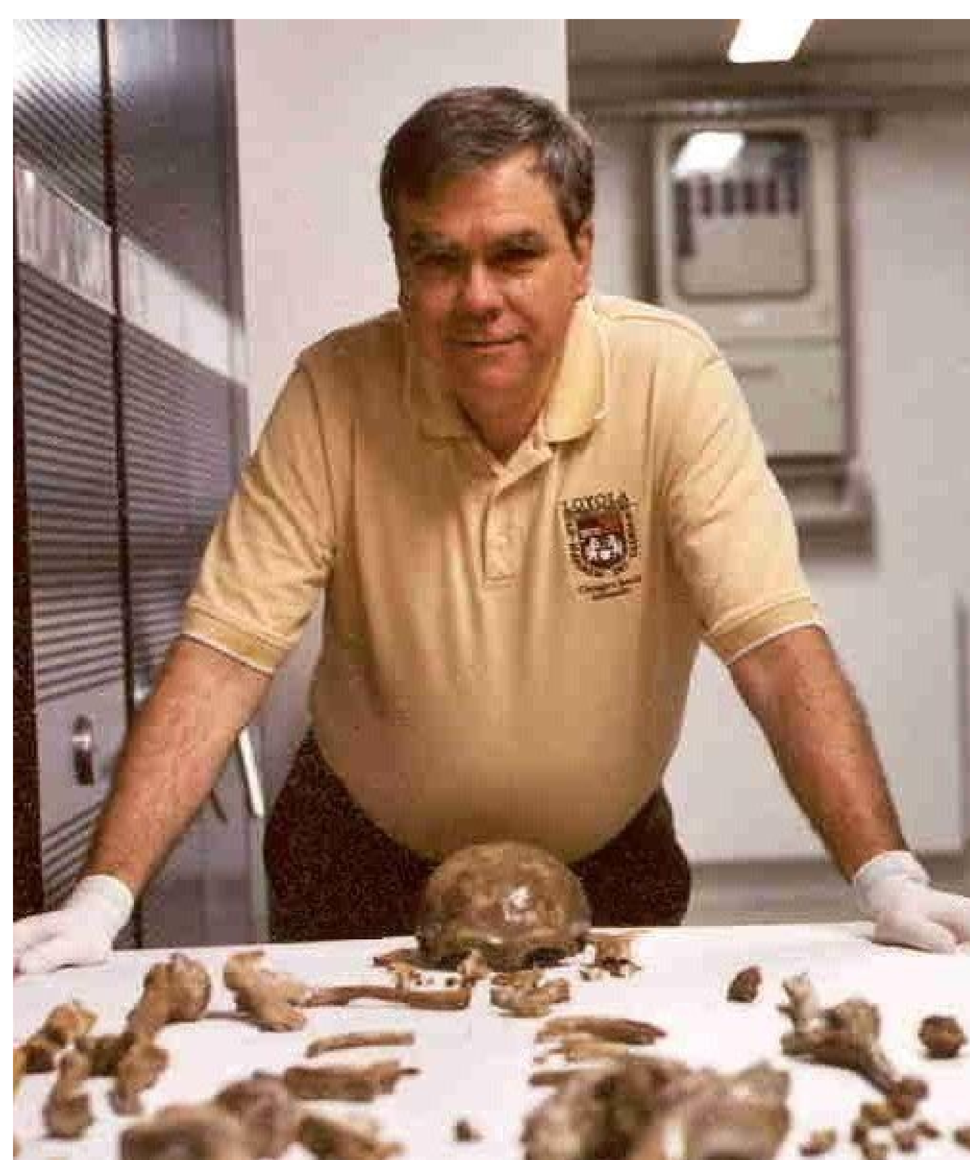
probably happened in Central Asia, especially in the Chinese Turkestan. Complex diffusional waves also act as a homogenization factor

Diffusional Wave theory does not rely on any preconceived anthropological notions. Instead, its basis is akin to the physical phenomenon of molecular diffusion and the laws that govern such a random process. This model agrees on east Africa as the point of origin of the ‘modern’ traits in early humans, thus coming close to the Out-of-Africa model, but insists on the genetic interaction with the already existing archaic Homo *sapiens* or even Homo *erectus* populations all over the Old World, thus borrowing some essential features from the Multiregional model, especially its *assimilation* version. Consequently, it does not require the replacement of the archaic by the modern. In its essence, it denies the speciation event that identifies a distinct biological species, called the ‘anatomically modern man’, that could not, and did not, interbreed with other members of genus Homo.

Eswaran suggests that most of the features associated with anatomical modernity most likely evolved in Africa as a co-adapted gene combination (or genotype). This genotype spread across the world because they *collectively* offered some strong selective advantage.

T h i s t h e o r y thus suggests, in contrast to the RecentAfrican-Origin model, that the emergence of modern humans was *not* a speciation but an intraspecies "character change". However, in contrast to the standard Multiregional Evolution model, it suggests that the emergence of the modern genotype was largely localized in Africa rather than being the product of a worldwide pattern of gene flow. This theory thus reconciles - to the extent that they can be reconciled - the two models within the framework of Wright's shiftingbalance theory.

Although broadly multiregional in spirit, the explanation of modern human origins presented by Eswaran is closer to Smith's theory (138, 146,147) than to the standard Multiregional Evolution model. It incorporates the basic elements of the shiftingbalance theory of Sewall Wright (see box). Smith's assimilation hypothesis is largely conceptual rather than a rigorous theoretical construct. The theory proposed by Eswaran, on the other hand, is a rigorous construct that provides a quantitative treatment, backed by a detailed mechanism by which, and the conditions under could propagate. balance theory, which itself is quite involved and exacting, figures quite prominently in Eswaran's thesis although low interbreeding rates, advanta



Fred H. Smith - *assimilation,* not *replacement,* is the evolutionary history of man

which, a coadapted genotype

Nevertheless, Wright's shifting geous gene combinations, and lowered childbirth mortality, which are

important, even central to Eswaran thesis, do not find significant mention in Smith's model.

The *Diffusional Wave* model stresses the spread of modern *traits* rather than the modern *descendants* of the human race. This it does through limited assimilation and hybridization with the preexisting archaic human populations, aided by selection and natural advantage of the co-adaptive modern set of traits. On the sideline, it gives us a logical way of thinking about human dispersal over the globe, opens a new way of seeking explanations for a number of intractable problems, and make it possible to interpret archaeological and genetic data from a fresh and novel point of view. In view of its capacity to answer a lot of questions, which the conventional concepts cannot, we need to dwell on it a little while. This description is, obviously, just an introduction; for details the reader should consult the original publications. (150,151,152).

It is suggested that the movement out of Africa was not a directional and discrete migration of humans in the general sense of the word but rather a continuous expansion of “modern” populations by small random movements, hybridization, and natural selection favoring the modern genotype. Thus, modern humans were not only *expanding* into space but also concurrently *evolving* through limited interbreeding with the already existing archaic humans, assisted by strong natural selection. A morphological advantage of the modern phenotype - possibly reducing childbirth mortality - is proposed as the cause of the transition.

The diffusion wave of a complex coadapted genotype differs from the gene flow of a single advantageous allele. It can spread only when there is a strong selective advantage for the genotype and a low interbreeding rate between demes. It would also propagate, unidirectionally and over vast distances. All this creates the impression of a migration. However, the diffusion wave is *not* a migration, for the diffusion wave is assumed to be directionally neutral. It is only the added effect of natural selection that causes the inexorable directional advance of the wave into regions populated by archaic humans.

The population expansion on the crest of diffusional wave of complex coadapted genotype is too often taken to mean a slow migration - which is *not* meant by Eswaran. By diffusional wave he means the strictly random-directional small movements of demes (say, small groups of huntergatherers) over generations. The advantageous genotype could have been carried whole by these demes and could have been broken up only when admixture ("interbreeding") occurred between members of different demes, one of which did not carry the genotype. Thus, if the interbreeding rate was low and the genotype advantage was high, there is the possibility that the population of demes carrying the modern genotype would have in

Wright’s shifting balance theory

The shifting balance theory is a theory of human evolution proposed in 1931 by Sewall Wright, suggesting that adaptive evolution may proceed most quickly when a population divides into uniquely adapted subpopulations followed by reestablishment of gene flow. The theory uses Wright's metaphor of fitness landscapes, attempting to explain how a population may move across an ‘adaptive valley’ to a higher ‘adaptive peak’. According to the theory, this movement occurs in three steps: (i) Genetic drift propels different demes (population groups) along different trajectories, facilitating an exploration of the adaptive landscape available to the species.
(ii) Intrademe selection allows some demes to reach

a new and higher adaptive peak.
(iii) Interdeme selection propagates the gene combinations that correspond to these adaptive advances and shifts the entire species to the new peak.

For all this to occur, the demes are required to be (a) small enough to allow significant genetic drift and (b) semi-isolated, to facilitate the formation of complex coadapted gene combinations that would otherwise be broken up by admixture.

Wright's was a rigorous analysis as the voluminous literature produced by him indicates. Shifting balance theory has been influential in evolutionary biology, inspiring the theories of quantum evolution and punctuated equilibrium. Although somewhat controversial, the shifting balance theory has been a picturesque and thought provoking metaphor that has proven helpful in incorporating a spatial dimension into our thinking on evolution.


Sewall Wright - the theory of *Shifting Balance*

creased at the expense of the others that did not; the genotype would then have spread out of Africa, or any other location, and across the world. Eswaran, along with Harpending and Rogers (153), investigated this possibility using a quantitative model and reached several interesting conclusions, mentioned below.

This mechanism is not just "gene flow" either - which is generally taken to mean a combination and admixture of genes such as is suggested by Wobst's picture of population groups fixed in location but genetically linked by mate exchanges (154). Eswaran argues that it is unlikely that an advantageous co-adapted gene combination could have spread in such circumstances: the gene combination would have been repeatedly "broken up" by inter-deme mating and would have adapted advantage upon such a breakup, thus limiting its spread.

Genetic Evidence: The model offers answers to a number of questions relating to the genetic

evidence, chief among which are the following: (1) *the African bottleneck* [why the "migration" out of Africa was apparently so small and only from the edge of the populations with the deepest genetic roots], (2) *Late Pleistocene population explosions* [why mitochondrial DNA (mtDNA) data indicate large population increases in Africa, Asia, and Europe that occurred as much as 50,000 years apart), (3) *the Pleistocene bottleneck* [why some genetic markers indicate low effective populations and coalescence times], (4) *differential bottlenecks* [why other genetic markers show large effective populations and high coalescence times], and (5) *differential genetic depths* [why non-African populations show lower genetic diversity than African populations in recent polymorphisms but comparable genetic diversity in ancient ones]. The explanations offered suggest that there must have been significant but not overwhelming *cumulative* genetic assimilation of archaics into modern populations as the diffusion wave progressed far from Africa.

Speed of the Spread of Modernity: While the possibility of long-range migrations is specifically disregarded, the model shows that anatomical modernity could have propagated as diffusion wave at speeds compatible with the known fossil record. The model simulations, computed with partly empirical and partly assumed parameters, also show how African neutral genes could have spread far, which would, without invoking a migration, indicate the African-derived genetic patterns in global populations today.

Disappearance of the Archaics: In the Replacement hypothesis, the disappearance of archaic lost its co

Thus, modern humans were not only expanding into space but also concurrently evolving through limited interbreeding with the already existing archaic

humans, assisted by strong natural selection.
Eswaran

humans has been speculatively assigned a variety of causes, some as extreme as genocide by modern humans. The theoretical framework provided by Diffusional Wave hypothesis allows us to suggest that, given a selective disadvantage and nonzero interbreeding rates, the archaics would have been progressively hybridized and would have essentially disappeared by hybridization. The model thus provides a compelling mechanism for the "extinction" of archaic humans. Hybridization, however, would have been confined to the relatively narrow "wave front" (where moderns and archaics coexisted), which may also explain why not many hybrid fossils have been found outside Africa.

Human Evolution and Early Human Social Structure: Eswaran suggests that human evolution was fundamentally facilitated by a social structure of

small demes linked by low interbreeding rates. This is required both for the formation of new genotypes by the shifting-balance process and for the spread of advantageous genotypes by diffusion waves. Such a social structure was possibly created in hominin populations - from even before the appearance of *Homo* - by an adaptive shift to collective hunting and scavenging. The operation of the shifting-balance process could explain the unique evolution of the human line as compared with that of the anthropoid apes.
The Apparent Bottleneck at the Wavefront: Because the wave front spreads faster than the modem groups behind it, the wave-front moderns are essentially isolated, except for such archaic assimilation as may occur. There is then a significant reduction of genetic diversity - an effective bottleneck. As the wave travel times are long and the effective size of the wave-front modern population small,

given sufficiently low archaic assimilation rates there will be a severe reduction of genetic diversity in the wave-front moderns. Thus correspondingly low genetic diversity will be passed on by the wave-front moderns to their descendant populations, which will all seem to have emerged from a bottleneck. This bottleneck will be only *apparent*, as the breeding population - including the moderns behind the wave front and the archaics ahead of it - need never have been small.

Recall that, according to this theory, (I) all assimilation from archaic humans would have occurred only at the wave front, (ii) the wave front would have been isolated from the moderns in its rear, and (iii) all new modern populations would have been created at the wave front, and therefore any signs of bottlenecking in the wavefront moderns would also have appeared in the emergent populations.

The Wavefront as a Mechanism of Homogenization: At low archaic assimilation rates, the genetic profile of the wave-front modern population would have changed slowly. Thus the descendant populations created along the wave path would have been closely related to each other. Even taking into account that there were probably several continental waves, given that they had the same initiating population in northeast Africa, a low rate of archaic assimilation, and wave-front bottlenecks, the entire world population would have been homogenized by the modern transition.

Origins of Races: Since populations along the same wave path (say, the European) would have been particularly closely related, with greatly reduced genetic distances, it is possible that the separate diffusion waves created the "races" and "sub-races" of present-day humanity.

The Apparent Coalescence Times: The wave-front bottlenecks and the consequent homogenization could explain why genetic diversity is low in human populations, as are the apparent coalescence times for some loci (particularly in mtDNA and Y-chromosome studies), and why so small a number, between 1,000 and 10,000 individuals, even less than 500, has been estimated by many geneticists as the effective size of the modern human lineage. The diffusional wave theory thus offers an alternate explanation for these empirical observations that have generally been interpreted as support for the Recent-African-origin-andreplacement model.

The Diffusion Wave as an Engine of Population Growth: An interpretation of the mtDNA data in terms of effective population sizes has shown that African, Asian, and European populations apparently had large demographic expansions that were respectively initiated approximately 100,000, 80,000, and 50,000 years ago and were possibly associated with the spread of modern humans. The diffusion wave explains these "population explosions" detected by mismatch analyses of mtDNA data. In the wake of the wave front, the populations descending from the bottlenecked wave-front moderns would initially have had a genetic unity, indicative of a small effective size. After the passing of the wave, however, the genetic diversity would again have increased in the emergent modern populations, and the indicated regional effective size would have approached the much larger actual breeding population, giving the impression of a large population increase.

Allele Loss at the Wave Front: The genetic diversity of present-day Africans at neutral DNA loci has usually been found to be higher than in all other populations. This is usually seen as support for the Recent-African-Origin model. However, in the diffusional wave theory, the same empirical observation is expected from the core region, where the modern genotype first evolved and modern humans have the deepest roots. Given a sufficiently low archaic assimilation rate and thus a slow rate of reduction of African parentage in the wave front, the latter would have carried many African neutral genes far out of Africa. However, if any African polymorphism had been lost from the wave

front it would not have traveled farther, as all long-distance transmission of neutral alleles occurs only by "surfing" on the wave front.

Unique African polymorphisms, carried along for as many as 4,000 generations by an effective population of about 2,000 individuals, would have suffered a severe decrease of genetic diversity because of the wave-front bottleneck. The farther the wave front traveled, the greater would have been the progressive loss of the unique African alleles-leaving "tracks" seemingly indicating a migration out of Africa. Furthermore, because of the bottleneck at the wave front, there would have been steadily decreasing genetic diversity away from Africa, given low assimilation rates. Both patterns have been observed in present-day populations, in single-locus and in multilocus microsatellite studies (107). While such evidence has generally been interpreted as supporting the recent-African origin model, it can also be explained in terms of the wave-front bottleneck, as proposed here.

Earlier Revolutions: Eswaran suggests that the Out-of-Africa diffusion wave of anatomical modernity may not have been a singular occurrence in human evolution. There are genetic and fossil clues that it had been preceded by another wave from East Asia. There may have been even earlier revolutions that swept through global human populations. Indeed, human evolution in the Pleistocene may have been characterized by multiregional evolution occasionally interrupted by worldwide "revolutions" caused by the rapid diffusive spread of advantageous genotypes created regionally by a shifting balance process. The multiregional evolution model too suggests that regional genotypes could have formed by a shifting-balance process.

Apart from this, there may have been other human "revolutions." That other transitions, from Homo *erectus* to "late" Homo *erectus* and to *archaic H. sapiens* occurred, is evident from the fossil record. Thus, human evolution in the Pleistocene may have been driven by a shifting-balance process that created regional phenotypes by genetic drift and local selection, propagating by diffusion waves those that were globally advantageous. The latter process—rather than speciation—possibly caused the revolutions apparent in the human fossil record. Thus, intra-species revolutions may even have led humanity through the various transitions in human evolution— supporting the possibility of there having been no cladogenetic speciation (as opposed to anagenesis) within the genus since the advent of *Homo.*

Compatibility with Archaeological Data: The essential features of the fossil and archaeological data also seem to be compatible with the diffusionwave hypothesis. The theory thus reconciles the diverse data on modern human origins. The model also suggests explanations for *(a)* the disappearthe fact that we view the past from the present ance of Neanderthal cultures in Europe and the (220).
contrasting cultural evidence from Asia, *(b)* the de
lay, compared with West Asia, in the modern transi
tion in Europe and East Asia, and (c) the fossil and
genetic uniqueness of Australo-Melanesia.

Big Question and the Loss of Innocence: Applications of Diffusional versus Migrational Spreads: The conceptualization of human dispersal in terms of genetic diffusion or as a set of ripples in a pond, seemingly trying to expand outward and going around any obstacles that it encountered, as

opposed to migration of discrete human groups in discrete and generally predetermined direction, has its consequences. If we subscribe to the former, how can we ask the question: where did my ances tors come from? what route did they take? and when did they migrate? There is no straightforward answer to these questions because in stricter sense there are no discrete ancestors, there is no defined migration route, and there is no travel itinerary. Eve rything is fuzzy and the whole situation is a contin uum and fluid. All we can do is to point to a vague direction, talk about the timings in an uncertain tone, and try to chalk out the frontiers of each suc cessive wave in terms of the diffusion of demes and genes. If this exercise gives one some idea as to who one's ancestors were, where did they come from, what route did they take, and when did they arrive, let one be happy with such a perceived truth. The fact still remains that if we seek the movement and migration of our 'ancestors' from one place of residence to another, then most of the time we would be deluding ourselves. The attempt to trace our genealogies beyond a few generations is a futile effort because we are a product of thousands of years of evolutionary process to which millions of our 'ancestors' have contributed their individual genes.

Conclusion: The course of human evolution and peopling of continents was possibly characterized by several episodes, or "revolutions," in which advantageous genotypes created regionally by a shifting balance process spread as diffusion waves across global populations. Such a process wherein the definition of "modernity" is changing continually through incessant, although punctuated, 'revolutions' and wherein human evolution is concurrent with human dispersal, the whole debate of the 'human dispersal', with which this Section has been devoted, becomes meaningless. A more significant question is whether "modernity" is actually a unique complex of features and even whether it can be validly defined apart from the description that modernity depicts people as they are today and in the recent past. If modern humans were a new species or an overwhelmingly superior anatomical and/ or behavioral variant they should have a package of unique, distinct features, but repeated attempts to identify such a package fail to include all recent or living people. This suggests that modernity is not a morphological complex but a perspective created by

III.3. Human Dispersal in Pakistan



Where, when, and how did the early humans first appear in ancient Pakistan? How did they spread over the whole Indus region and beyond? When did they arrive here? and how? Furthermore, what happened to those who lived there before them? These questions are difficult to answer because we have practically nothing to base our speculation on: no human fossils, no camping sites, and no artifacts; only a limited group of stone tools discovered in Pothwar, Shangao Caves, and the Rohri Hills. We are also not lucky to find much of an evidence in the neighboring region beyond the discovery of a fossilized human skull in the Narbada Valley in India and a few bones in a cave of Badakhshan, in Afghanistan. Nevertheless, since the questions are important ones, we have no choice but to address them, or at least speculate on them.

The general question of the evolution of humans and their spread in Eurasia is basic, but we are mainly concerned here with the dispersal of modern humans in Pakistan or at least in South Asia of which Pakistan is a part. This can be theoretically divided into three periods and can be studied accordingly:

1) the colonization of the Indus Valley and the surrounding highlands by early humans and their ancestors, like Homo *erectus*, archaic Homo *sapiens*, and their various transformations, prior to about 70,000 years ago;

2) the peopling of this area by Homo *sapiens sapiens*, the so-called ‘modern humans’, after this point; and

3) the spread of more recent genes, some of them even in historic times.
This division is not as stark in South Asia as is in evidence in case of Europe but it does serve its purpose in simplifying the issue at hand. Since Pakistan and the borderlands are poor in fossil and skeletal evidence and since the rich assemblages of its stone tools have not yet been studied from the point of view of the spread of humans, our best bet is to study the dispersion of early human populations in Pakistan in context with Eurasia and, wherever possible, in context with South Asia as a whole.
Over the last decade, archaeological and genetic research has identified South Asia as a crucial new frontier in the study of human evolution and dispersal and this archaeological and anthropological potential has now started to be increasingly explored. Archaeological evidence is rather patchy and fossil record is almost non-existent; genetic studies are, however, plenty. These studies suggest that this region holds important clues to understanding the evolution and structure of human diversity outside Africa. The genetic signatures in current populations vary from the persistence of physical traits, such as skin color and body size, that may have originally developed in Africa, to unique genetic sequences that may have evolved in South Asia itself (97,101,155,156).

Artifacts of chipped stone dominate the Pleistocene archaeological record of Pakistan and these assemblages play a central role in the study of humans' remote past in this region, providing evidence for the documentation and evaluation of the origin and duration of regional occupation, changes in manufacturing technologies and reduction techniques through time, relationships between stone tool assemblages and particular habitats and resource bases, and variations in the distribution and attributes of materials as a reflection of activity and mobility. Archaeologists have devoted much attention to understanding how this material may be used to discern temporal and spatial trends and functional relationships. In quite a few instances, the analysis of stone tools typology and its variation with time and space has also helped to figure out the movement of human population groups and the duration of their occupation in various areas. Such studies continue to play a vital role in formulating hypotheses about the dispersal of our ancestors over this land.

Section II examined the evolution of man and changes in human populations by employing information collected from different fields of inquiry, including archaeology, anthropology, and genetics, collected from different parts of the Old World. Chapter 1 of the present Section discussed the dispersal of humans in generalities and Chapter 2 briefly brought South Asia in focus. The present chapter focuses on Pakistan but in a way it is an extension of the discussion on South Asia. Just like South Asia generally, the study of human dispersal in Pakistan is primarily based on archaeological record from the Pleistocene but genetics and paleoenvironment also weigh in quite heavily. This includes the faunal fossils from this period, the geological formations that can be easily and securely 'read', and a large assemblage of stone tools, some of which have been securely dated. This archaeological and environmental record has much to contribute to our understanding not only of the human dispersal in Pakistan but also in the neighboring regions of India, Iran, and Central Asia. Since direct information available to us is limited and patchy, we need to utilize the data available from other comparable regions for enriching our interpretations about how the ancient world of foragers in Pakistan was shaped. This necessitates the study of human dispersal in this land in context with that of the neighboring regions and that of Eurasia as a whole. All this may not be sufficient to decipher the chronology and mechanism of initial colonization, but a story definitely emerges, which is both credible and coherent.

The neighborhood context is particularly important and any information that can be gathered there can be extremely useful. The availability of such a help is, however, limited.To begin with, there is not enough Paleolithic or genetic data available from Central Asia, Afghanistan or Iran to warrant a study of the early inhabitation of Pakistan from the vintage point of the West. The data from India is somewhat better and more diverse and these can be used to understand some aspects of the peopling of Pakistan. We must, however, keep in view the reality that while Pakistan shares many common features with the rest of the subcontinent, there are several differences too.

First of all, there is a stark difference between the environmental features of Pakistan and those of India in general. While most of India is fed by the monsoons, they are not very significant in Pakistan. Pakistan is largely an arid land, an eastward extension of the Sahara through the arid regions of Arabia and Iran. Second, while most of Pakistan lives on winter rains, as meager as they are, they are insignificant factor for a major part of India. Third, there has been a formidable and extensive barrier between Pakistan and peninsular India in the form of the Thar Desert. This has inhibited not only the dispersal of humans across these two regions but has funneled them eastward through two narrow corridors; one at the southern end of the Thar, skirting the coastal area of Kutch, and one at its northern end, all along the foothills of the Himalayas (see Chapter I.3 for details). Because of this impediment to the flow of men and beasts, genetic interaction between the two regional populations remained greatly reduced. A d d i t i o nally, Pakistan's northern and western boundaries are along the highlands where the Indian tectonic plate collides with that of Asia and a large part of the

geographical features of Pakistan is the result of this geological collision and the subsequent tectonic upheavals from time to time. This is in contrast to the topography of India where tectonic activities have been infrequent and milder. Because of these differences in paleoenvironment and because of a formidable impediment to human movement across the borders, the archaeological and genetic information that may be available from the East should be used with caution.

Coming back to archaeological evidence, the analysis of the stone artifacts found at several locations in Pakistan attests to the presence of hominins in this region at an early stage of human evolution. Given the received wisdom that early humans evolved in East Africa and from there they spread all over the globe, the date of their arrival in South Asia was pinned down to about one million years ago. Subsequent research, however, changed this perception and this date has recently been pushed back almost to 2 million years ago. The received wisdom also tells us that the 'modern humans', i.e. Homo *sapiens*, also evolved in East Africa and that they came to the sub-continent from the West, ostensibly from a Eurasian population that had its roots in the Levant (157,158) somewhere around 50,000 years ago. This premise is still implicit in maps of modern human expansions and colonization of continents. Some genetic studies support this scenario but more specific studies highlighting the importance of Pakistan in the global expansion of modern humans paint another picture

- migration of modern humans directly from East Africa prior to 70,000 years ago (23,91,103), probably before 100,000 years ago (76).

The prehistory of Pakistan is rather remarkable, as has been documented in many articles and research reports. These compendia clearly demonstrate the presence of a wide range of archaeological sites, many providing significant cultural information. Among the better known of these sites are the occurrences of very early stone artifacts of Oldowan type in the Soan Valley, the two securely dated Acheulean sites in Pothwar, the Paleolithic rock shelters in the Peshawar Valley and the Bajaur Agency, a number of factory sites in the Rohri Hills in upper Sindh and Ongar in lower Sindh, and several Mesolithic sites throughout Sindh, Las Bela and the coastal regions. Additional information is available from research in the adjoining areas of India that can be extrapolated and applied to the comparative situations in Pakistan.

While archaeological record is sufficiently strong and the potential for newer discoveries is high, the early Pleistocene of Pakistan, and that of South Asia as a whole, has received only marginal academic attention in the past and, until recently, it was rarely considered in human evolutionary syntheses (174). This is besides the fact that South Asia, Pakistan in particular, has featured heavily in models regarding the initial colonization of Australia and Southeast Asia (150). This situation is rather abnormal given that Pakistan contains numerous identified archaeological sites and a sizable literature on early human occupation (156). This is partly explained by a lack of early hominin fossils, a dearth of excavated sites and few associated chronometric dates. These drawbacks are, of course, directly related to the lack of adequate funding and technical knowledge, complex bureaucracies, and a general lack of interest in paleoanthropology of the region. Notwithstanding this lack of interest and financial support, archaeologists have finally begun to identify Pakistan as a crucial new frontier in the study of human evolution and dispersal. The British Archaeological Mission, in 1980s, has been a substantial boost toward that direction.

Though significant field work and research has been conducted in Pakistan since 1930s, serious problems hamper a fuller understanding of human evolution and societal change, including the absence of hominin fossils, too few well-excavated sites revealing behavioral and social information, a poverty of detailed inter-disciplinary studies to recover paleoecological data, and poor chronological controls. To make matters worse, scholarly research and interactions may sometimes be impeded by a severe lack of interest in Pakistani academic circles in prehistory of the country, not

to speak of the Stone Age. Yet, as illustrated by the work cited in this volume, much can be gained by the past scholarship and the current inter-disciplinary research. We shall discuss the question of human dispersal in Pakistan from archaeological as well as genetic perspectives, followed by the results of GIS modeling of human dispersal in South Asia. Of course, repeated references to the material already covered in the foregoing pages would be necessary in order to avoid unnecessary repetition. We begin with a reconstruction of Paleoenvironment of South Asia, particularly in those features in which Pakistan differs from the rest of the subcontinent.

Paleoenvironmental Reconstruction: The geography of the land is outlined in Chapter I.3 and some details on the Pleistocene environment can be gathered from Chapter I.4. Here we touch upon a few features that are particularly pertinent to the subject at hand.

Pakistan is dominated by the Indus River and is almost synonymous with the Indus Valley. The Indus plains are a vast area, mainly an arid zone but irrigated by five main rivers and a large number of smaller water streams, almost all of them are the tributaries of the Indus system. Pakistan’s western boundaries are the Sulaiman mountains, which are, in a way, an extension of the Hindu Kush or the Iranian Plateau.

As explained in Chapter I.3, contrary to the appearance on the map, Pakistan is geographically more a part of Central Asia than that of the Indian subcontinent; a large number of passes through the western highlands connect it with northern Iran, Afghanistan, and Central Asia. These passes have in antiquity worked as funnels which directed the flow of humans and beasts to this land, and the Sulaimans have acted as a saddle around which varied population groups with diverse racial affinities have been congregating since the first appearance of man in this broad region. Like India, Pakistan is boxed in by the high Himalayas, the foothills of which constitute the Siwaliks and the Pothwar Plateau. The Pamir Knot, from where modern humans apparently dispersed to colonize the vast area of Central Asia and significantly contributed to the genetic mix of Pakistan’s current populations as well, is a part of this topography; so is the Pothwar Plateau in the north of Punjab an incubator of humanity in South Asia.

Marine Isotope (MIS) or Oxygen Isotope Stages (OIS)

Marine isotope stages (MIS), marine oxygenisotope stages, or oxygen isotope stages (OIS), are alternating warm and cool periods in the Earth's paleoclimate, deduced from oxygen isotope data reflecting changes in temperature derived from data from deep sea core samples. The data is derived from pollen and plankton remains in drilled marine sediment cores.

The MIS timescale was developed from the pioneering work of Cesare Emiliani in the 1950s, and is now widely used in archaeology and other fields to express dating in the Quaternary period (the last 2.6 million years), as well as providing the fullest and best data for the study of the early climate of the earth. Emiliani's work in turn depended on Harold Urey’s prediction in a paper of 1947 that the ratio between Oxygen-18 and Oxygen-16 isotopes in calcite, the main chemical component of the shells and other hard parts of a wide range of marine organisms, should vary depending on the prevailing water temperature in which the calcite was formed.

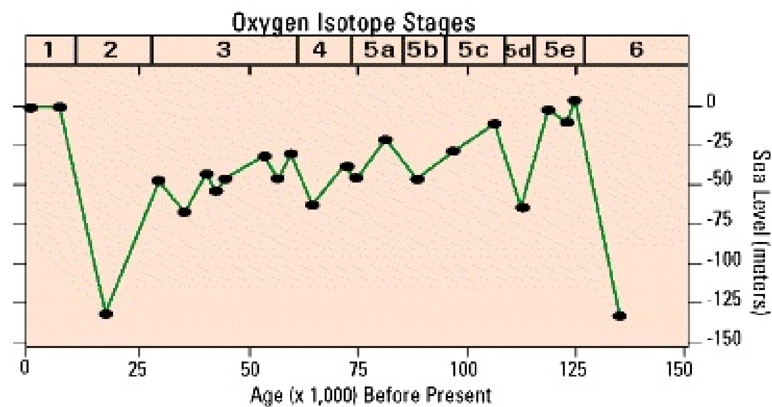
Working backwards from the present, MIS 1 in the scale, stages with even numbers have high levels of oxygen-18 and represent cold glacial periods, while the odd-numbered stages are troughs in the oxygen-18 figures, representing warm interglacial intervals. Over 100 stages have been identified, going back some 6 million years. Some stages, in particular MIS 5, are divided into sub-stages, such as "MIS 5a", with 5 a, c, and e being warm and b and d cold. A numeric system for referring to

"horizons" (events rather than periods) may also be used, with for example MIS 5.5 representing the peak point of MIS 5e, and 5.51, 5.52 etc. representing the peaks and troughs of the record at a still more detailed level. For more recent periods, increasingly precise resolution of timing continues to be developed.

The following figures for approximate dates, taken from the list on Lorraine Lisiecki's website, are given for the past several thousand years.

MIS 1: ! 14,000 years ago - Present! Warmer MIS 2: ! 25,000-14,000 years ago! ! Colder MIS 3: ! 55,000-25,000 years ago! ! Warmer MIS 4: ! 70,000-55,000 years ago! ! Colder MIS 5: ! 120,000-70,000 years ago!! Warmer MIS 6: ! 191,000-120,000 years ago! Colder MIS 7: ! 243,000-190,000 years ago! Warmer

The geographic features in the East are equally important in determining the flow of populations in ancient times. This especially applies to the Thar Desert, the Great Indian Desert that lies between Pakistan and India, almost all along their mutual boundary, from northeast to southwest. Its role in keeping the two regions culturally and genetically separated from each other during the entire prehistoric times has been largely ignored by archaeologists and prehistorians for long but is now slowly coming to their attention (190,191,192). We have taken a rather detailed note of this feature in Chapter I.3.



Oxygen Isotope Stages and sea-level fluctuations for the past 140,000 years based on correlation of deep-sea core data with the ages of uplifted and drowned coral reefs

dry seasons, and present vital water supplies for sustaining domesticated plants and animals. Fluctuations and shifts in the intensity of rainfall are registered through time, in part due to the HimalayanTibetan uplift caused by tectonic activities. The stratigraphic record in the Thar Desert in Sindh and Cholistan demonstrates that phases of aridity (and dune formation) are sharply interspersed with periods of wetter, ameliorated climate. Monsoonal shifts during the Pleistocene and marked seasonal changes in wet and dry periods are thought to have structured hominin settlement behaviors and the survival of populations (193).

(*Chappell and Shakleton, 1986***)**

Within South Asia, Pakistan is a large and complex region, and, like other parts of South Asia, the modern climate and environment bear only partial resemblance to the conditions of the Middle and Late Pleistocene, when a major part of the country is believed to have been settled. Major terrestrial features, such as the Indus Rivers and tributaries, have shifted their locations across the landscape

(187) and produced extensive Holocene-aged deposits that overlie earlier Pleistocene-aged ones. Uplift and regional aridity have changed the activity patterns of fresh water sources, and either increased or decreased sediment loads in major drainages. These and other changes suggest that environmental dynamism and localized transitions were the norm for this region, and modern reconstructions must take these paleogeographic features into account as much as possible.

Pakistan is a semi-arid, subtropical environment with characteristic harsh summers and equally noticeable winters. Unlike India, the monsoon is not of fundamental importance for sustaining life on the plains.The winter rains, as meager as they are, are, however, important. Rainfall patterns shape the distribution and abundance of flora and fauna, offer essential nourishment to stressed ecologies during

Seasonal and spatial fluctuations in rainfall are known to have occurred episodically in the past, opening up some of the more extreme environments to habitation during brief periods. Archaeological sites in the Thar Desert demonstrate periods of wet conditions (162-165), interspersed with relatively dry periods. The drainages that originate in the Himalayan and the Hindu Kush ranges would have experienced instances of lateral shift and abandoned channels downstream, especially in Sindh and the Indus Delta due to increased sediment load. Discharge in these regions was enough to form large lakes in the broad shallow valleys which transitioned into dry basins as aridity returned. The remnants

of these lakes dot the whole eastern zone of southern Pakistan.

Along with these major geographical features, the natural water springs in the western Sindh and eastern Baluchistan must have played an equally significant role in the dispersal of human populations in the Greater Indus Valley. Similarly, periodic aridity suppressed vegetation in the higher elevations in the north and the northwest of Pakistan, resulting in a topographic mosaic of dry deserts and relatively wetter valleys throughout the sub-Himalayan and the Hindu Kush ranges (158). Palynological cores and faunal remains from the coastal areas indicate that much of the interior of Pakistan was covered with dry savannas and grasslands during glacial periods (187). Mangroves would have been present at times along the coastal shelf and the Indus Delta, with increases and decreases in mangrove expanses signaling variations in monsoonal rains in the North and discharges of outflow in the South. These punctuated change that occurred within the time frame under consideration may have had a profound impact on hominin populations in Pakistan and must have affected the expansion of modern humans in this region.

The late Pliocene and early Pleistocene (*ca.* 2 million years ago) are particularly important in the study of human dispersal in Pakistan. This time period of Pakistan (and India) are represented by the Upper Siwaliks, or more specifically, the Pinjor Faunal Stage. This name derives from a locality near Chandigargh, India, although the Pinjor is best indicated in the Pabbi Hills in the Pothwar region and the Mangla-Samwal area of northern Pakistan.

As elsewhere in South Asia in the late Pliocene and early Pleistocene, conditions appear to have been generally moister than in later periods. The largest amount of dated vertebrate fossil material comes from the Pabbi Hills, where over 40,000 specimens have been collected by the British Archaeological Mission to Pakistan during 1980s, with roughly half from horizons between 1.8 and 2.2 million years ago and the rest from horizons 1.2–1.4 million years ago (21). The older horizons contain remains of a very large bovid (type unknown); a small primate; and several other unknowns. The herbivores in

this group were probably browsers, and their disappearance after 1.8 million years ago may indicate a contraction of woodland and the development of more arid conditions similar to that observed at Koobi Fora in Africa. The fauna is otherwise dominated by grassland and open woodland types, notably Equus and Rhinoceros; a variety of medium-sized bovids; Gazella; Elephas; Stegodon; and ostrich.

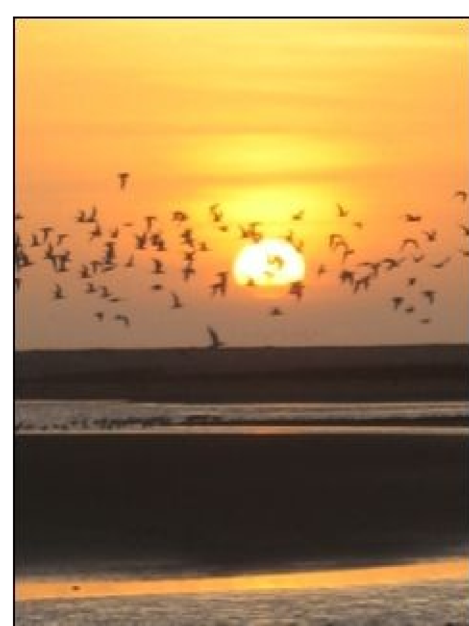
Some details on the Pleistocene environment are offered in Chapter I.4: here we briefly touch upon a few climatic features specific to this region. We do this with reference to the Oxygen Isotope Stages (OIS) which are also referred to as Marine Isotope Stages (MIS), discussed earlier.

Geological research has established that the ratio of oxygen isotopes O^{18} and O^{16} from the strata of deep-sea ocean sediment cores provides an index of global glaciation and deglaciation in prehistory. Within this cycle, Oxygen Isotope Stages demarcate the boundaries between long-term trends of global warming or cooling. Stages 2 (24,000– 13,000 years ago) and 4 (71,000–59,000 years ago) were the most recent full-glacials, while Stage 3 (59,000–24,000) was a temperate, variable period, generally called interstadial. Stage 4 and Stage 5 are generally associated with the Middle and Late Pleistocene and hence with the dispersal time of ‘modern’ humans in South Asia and beyond in the Far East. In broad outline, the conditions of OIS 4 are thought to approximate (although to a somewhat lesser extent in terms of extremes in temperature and aridity) what is known for OIS 2 (the last glacial maximum, 24,000–13,000 years ago. Stage 5, on the other hand, is an interglacial period, similar to Stage 3, and falling between 70,000 and around 100,000 years ago.

The OIS-4 is important in the story of human expansion in South Asia. It is a glacial period in temperate regions of the North but its effect are equally felt in tropical regions of the South. Generally, the onset of glaciation and cool temperatures in the higher latitudes led to global decreases in sealevels, and increasing aridity in the tropics. Increased seasonality between summer and winter temperatures was also prominent. For much of the Old World, this would have resulted in the expansion of desert conditions throughout North Africa, Arabia, and part of South Asia, as well as an increase in savanna-type conditions and dry tropical forests in the tropical latitudes, in particular South Asia and Southeast Asia. During OIS 4 the Red Sea would have remained connected to the Arabian Sea via the Bab al Mandab Straits; however, the Persian Gulf would have disappeared entirely, leaving a substantial expanse of sand dunes in its place (158) or a series of freshwater lakes fed by rivers like Euphrates. Coastal environments, such as expanses of sand dunes, mangroves, alluvial plains, coral reefs, and lagoon systems would also have been affected by increasing/decreasing sedimentation, changing wind and rainfall patterns, and sea-level fall during the OIS 4 period. Glaciation also implies that the monsoon system that normally provides seasonal moisture would have been suppressed across the Indian Ocean basin, resulting in greater aridity along much of the Indian Ocean rim.

However,it must be noted that in addition to these general trends for OIS 4, there is increasing evidence to suggest that there was regional variation in both temperature and humidity during and after glacial periods, which resulted in episodes of wetness in the desert environments of North Africa and South Asia. These events extended to both century and millennium time scales, and their timing appears to lag deglaciation by approximately 3000 years, suggesting that monsoon intensity would have increased at the end of OIS 4. These episodes would have also led to an increase in vegetation and wildlife in what were formerly desert environments, and perhaps also attracted populations into regions that had previously been avoided. Rapid transitions between periods of

aridity and wetness would have had an impact on the subsistence regimes and mobility of populations that may have resided in these regions at this time. Although the chronology and frequency of these events have not been fully ascertained for OIS 4, enough is known for the sake of this discussion.



Unlike migrating birds, early humans were moving into new locations which were completely unknown to them till then.

South Asia is a large and complex region, and the modern climate and environment bear only partial resemblance to the conditions of the Middle and Late Pleistocene. Major terrestrial features, such as the Indus and the Ganga rivers and their tributaries, have shifted their locations across the landscape (159) in post-OIS-4 era and produced extensive Holocene-aged deposits that overlie earlier Pleistocene-aged ones. Uplift and regional aridity have changed the activity patterns of fresh water sources, and either increased or decreased sediment loads in major drainages. These and other changes suggest that environmental dynamism and localized transitions were the norm for South Asia, and modern reconstructions must take these paleogeographic features into account as much as possible.

If a hominin as small-brained (and probably as short) as those at
Dmanisi could colonize southwest
Asia by 1.7 million years go, why not at 2.6 million years ago,
shortly after stone tool making became part of the hominin repertoire [in Pakistan]? Robin Dennell in *Pa*

leolithic Settlement of Asia

The dynamic fluctuations of the monsoon system are thought to have had a major impact on human populations throughout South Asian prehistory (160). Seasonal and spatial fluctuations are known to have occurred episodically in the past, opening up some of the more extreme environments to habitation during brief periods. For example, archaeological sites on the fringes of the Thar Desert in Sindh and Rajasthan demonstrate periods of wet conditions (161,162,163) interspersed with dry periods. Episodic monsoon activity had a variety of effects on the river systems of the subcontinent. The drainages that originate in the Himalayan ranges would have experienced more instances of lateral shift and abandoned channels due to increased sediment load and post-monsoon discharge,

whereas the rivers of the south (Peninsular India) would have maintained broad shallow valleys on a rocky landscape, with little instance of braiding. However, discharge in these regions was enough to form large lakes in the broad shallow valleys which transitioned into dry basins as aridity returned. This pattern is quite common in peninsular India as well as in eastern parts of Sindh.

Lastly, some periods of sudden change that may have occurred within this time frame may also have had an impact on human populations in South Asia. For example, ash and tephra deposits located throughout South India are known to be the product of a volcanic eruption, specifically the supereruption of the Toba volcano in Indonesia between 71,000 and 74,000 years ago (164). It was long believed that the after-effects of this eruption resulted in a population crash for all terrestrial organisms, including human populations (82). The magnitude of this event and its effects on human populations in South Asian prehistory is not yet clear but recent research has indicated a technological continuity between the pre-Toba and the post-Toba populations, thus negating any catastrophic effect of human populations in this region.

Dispersal of Early Hominins in South Asia: While we are primarily concerned in this chapter with the first colonization of South Asia by *modern* humans in late Pleistocene, some 50,000-100,000 years ago, we are equally interested in looking into the spread of early hominins over this land in the early and the middle Pleistocene, between 2 million and 100,000 years ago. We are especially interested in the answers to such questions as the timing of the first colonization of this region by whosoever early humans they might be, identifying the hominin specie(s) that may have occupied Early Stone Age of this land, and the factors responsible for techno-cultural changes. Our present knowledge does not yet provide a robust empirical or analytical base for finding satisfactory answers to these questions. However, a large amount of Paleolithic and faunal data has accumulated over the past century and this provides us with some pointers to speculate on early hominin dispersal in this part of the Old World. Some of these pointers, especially those that indicate the presence of early hominins in South Asia, have already been indicated in the last chapter as well as in II.3; the following remarks are somewhat complementary in nature.

Four features mark many overviews of the dispersal of early hominins in Asia (21). The first is that until recently few have paid much attention to the environmental factors that may have aided or impeded the processes of colonization. Beyond noting that Homo *ergaster* was fully bipedal and endowed with, ‘‘a typically insatiable human wanderlust’’ (166), it has been assumed that only the severest of geographical obstacles might have impeded their inexorable progress across Asia. Likewise, based on purely genetic data, the alleged dispersal of hominins from Africa across the rest of the Old World is envisaged as largely unaffected by desert or rainforest, mountain or plain. This important and far-reaching conclusion is drawn from the straight line relationship between genetic diversity and geographic distance from South Africa, shown by many researchers in the past, the latest being by Liu et al (167). Surprisingly little attempt has been made to integrate genetic data with the archaeological and fossil record from Asia and the increasingly high quality paleoclimate records from the loess sequences.

Second, archaeological, fossil, and climatic records have been used quite selectively, giving primacy sometimes to the fossils, sometimes to the artifacts, and rarely to the environment. This has skewed the interpretations drawn from the available material. As Dennell (21) points out, it seems unwise to ignore the best paleoclimatic Asian record simply because it is derived from areas devoid of artifacts, or to ignore the South Asian archaeological and environmental data simply because there are no

fossil remains.

Third, with a few notable exceptions, it is often implicitly assumed, in attempts to write culture histories or human phylogenies as continuous narratives, that initial dispersion was followed by colonization and sustained occupation (168). In the Lower Pleistocene in particular, it may be more appropriate to assume that there were numerous hominin dispersal events that were geared to the most favorable environmental conditions, and to assume also that occupation was often discontinuous and intermittent, as argued for Europe 500,000 years ago (169,170).

Lastly, it is customary to subdivide Eurasia longitudinally - Europe west of the Urals (35º E), and Asia east or west of the Movius line, roughly 100 E. As argued by Dennell (14,21), latitudinal divisions may be more appropriate in discussions of early hominid dispersions, with boundaries primarily between warm/hot and cool/cold environments. These boundaries would, of course, vary between glaciations and interglacials and also across Asia, because climate is not just simply a matter of latitude. Chicago and Rome, or Beijing and Naples, for example, have very different winter climates even though each pair lies on the same latitude.

In recent years, much interest has been aroused, both publicly and academically, by the possibility that early hominins may have occupied large parts of Asia by a little under two million years ago, rather than the substantially later date of around one million years ago, as was previously and commonly believed. As described earlier, the doubling of the antiquity of hominins in Asia has been brought about by a handful of new discoveries and the redating of older ones. New discoveries include the superb hominin remains and stone artifacts from Dmanisi, Georgia, dated to a little under 1.8 million years ago (171); claimed hominin remains and alleged stone artifacts from the fissure at Longgupo, China, which may be as old as 1.8 million years ago; convincing examples from Riwat, Pakistan, of intentionally flaked stone in a horizon dated by both the discoverers (21) and previous, independent geological teams to the late Pliocene, *ca.* 1.9 million years ago; and most importantly, the re-dating of the hominin remains from Sangiran and Mojokerto,


Archaic humans before the advent of the modern man (museum photo)

Java to 1.81 and 1.66 million years ago (172). The Javan dates are critically important here, for not only were these hominins long regarded as being less than one million years old, but until the discoveries at Dmanisi, they were also the only lower Pleistocene hominid remains between Southeast

Asia and East Africa, some 8000 km to the West. Even though the dating, context, and/or identification of each of these finds has been criticized, the suggestion that hominins first occupied Asia around 2 million years ago has become an almost orthodox view within paleoanthropology.

The artifactual evidence from Riwat in Pakistan is significant in context with South Asia. It puts the presence of hominins or their ancestors in the Pothwar Plateau even prior to 2 million years. If we concede to these early dates of hominin presence in northern Pakistan, and there is no reason why we should reject this evidence, but accept the evidence from Dmanisi, Georgia, and the Far East, we are

facing the fact that the first hominins that announce their presence in Pakistan were not the Homo *erectus* but something like Homo *habilis*. Now, if a hominin at the same grade as Homo *habilis* was able to exist outside Africa, why not others? If a hominin as small-brained (and probably as short) as those at Dmanisi could colonize southwest Asia by 1.7 million years go, why not at 2.6 million years ago, shortly after stone tool making became part of the hominin repertoire? Or why not even earlier, by, for example, 3.0–3.5 million years ago, when the Saharan–Arabian desert barriers did not yet exist? "If it is expected that by 3.5 million years ago hominids were distributed throughout the woodland and savannah belt from the Atlantic Ocean across the Sahel through eastern Africa to the Cape of Good Hope (173), why could they not have done the same across the

grasslands of western, southern and central Asia?" ask Dennell and Roebroeck (174).

This is the question of great interest to paleoanthropologists and the obvious retort to these questions is that there is no evidence that australopithecines did migrate out of Africa. However, "absence of evidence is not enough; we need convincing evidence that the absence is not the result of taphonomic circumstance or lack of fieldwork, especially in a continent as large as South Asia" reply Dennell and Roebroeck (174). In their opinion, we need to consider alternatives to the current Out-ofAfrica model. There are three issues here (174). The first is when hominin(s) first left Africa might they, for example, have left shortly after they acquired the ability to make stone tools, the earliest of which are currently 2.6 million years old? Or, could they have left even earlier, about 3.0–3.5 million years ago, when some australopithecines were already living in the African grasslands? If we do not accept this proposition, then how do we explain the early evidence from Pothwar?

The faunal evidence from Pakistan, at least in general terms, indicates that the conditions in late Pliocene and early Pleistocene in Pakistan were more or less the same as those in northeastern Africa and south-western Asia - considerably moister than at present. Grasslands were prevalent across much of southern Asia, probably grading into open woodland in Southeast Asia. Both the loess and deep-sea records indicate numerous, but low amplitude, climatic fluctuations at this time with a periodicity of *ca.* 41,000 years. Consequently, latitudinal shifts in vegetation and fauna are likely to have been moderate between southern and central Asia. Overall, hominins would have encountered essentially the same conditions as in East Africa, and their presence across South Asia *ca*. 2 million years ago can be regarded as simply a latitudinal dispersion into the type of habitats they already utilized in East Africa.

If, as suggested, grasslands and a moister regime prevailed right across South Asia from Arabia to Pakistan, and northward to Central Asia and north-central China, and if the Red Sea and Nile were less effective faunal barriers than now, there would have been little impediment to hominins extending their range eastward across south Asia - apart from the Zagros Mountains in Iran. Current data are insufficient to establish the full extent of hominins in the Asian grasslands at this time. However, we

might note that late Pliocene australopithecines are assumed to have been endemic to the African grasslands on a continental scale (21), and so we might cautiously assume that genus Homo was similarly ubiquitous throughout the South Asian grasslands in the late Pliocene and early Pleistocene. Indeed, we should not exclude the possibility that they may have been resident in Asia at an even earlier date. Dennell (175) and Turner (176) have both suggested, for example, that hominids might first have appeared in southern Asia in the late Pliocene well before 2 million years ago, when conditions were more favorable than later. Overall, the current scant evidence is best interpreted as a latitudinal extension of hominids by 1.8 million years ago across southwestern and southern Asia into grasslands south of ca. 40º in west Asia (with Dmanisi at 41º N in an unusually warm cul-desac and currently the most northerly acceptable piece of evidence) and perhaps further eastward.

In short, it is now time to reflect on what we have seen in the lithic record of Pakistan and South Asia generally and try to figure out the trajectory that humans have followed in South Asia in their evolutionary journey and cultural change. Stone artifacts are our primary evidence in this quest but, as is evident from the discussion in Chapter II.3, they do not tell us the whole story, they need to be examined under the light of population genetics and relate to fossil evidence in the region. More importantly, we need to exercise of imagination and employ quite a bit of conjecture for making sense of the evidence in the framework of theoretical models of one kind or the other.

As stated in the foregoing, Pakistan is not rich in human fossils but the archaeological evidence for an early presence of tool-making hominids is strong. This consists of stone implements found in the Soan Valley of Pothwar Plateau in northern Pakistan. Among the earliest tools discovered in this region, a few have been dated to 1.9-2.1 million years ago. This evidence is in consonance with the antiquity of hominins in Asia in general, as already discussed in Chapter II.3. and II.4. Here we begin with the secure knowledge, derived from stone artifacts, that early hominins occupied parts of Pakistan, especially the Pothwar region in the north of Punjab, as early as the Early Pleistocene or even the Late Pliocene, some two million years ago.

Because of this unexpected antiquity of human presence, dating the first appearance of hominins in Pakistan has been put in dispute and is currently one of the major problems in studies of human evolution. “The nature and timing of this extra-African dispersal is now a central problem in paleoanthropology, and the general deficiency of Lower Pleistocene human fossils and/or archaeological occurrences throughout western and southern Asia severely limits any efforts towards its resolution” (194). These deficiencies are caused by two main factors that merit some attention.

The first is the difficulty of demonstrating that crudely flaked stone objects found in Pothwar and dated to 1.9-2.1 million years ago were modified by hominins rather than by geological agents. This is not a new problem in lower paleolithic archaeology, and the discrediting of the ‘eoliths’ of East Anglia in Britain and the Kafuan ‘pebble tool industry’ of East Africa, are familiar cautionary tales to students of archaeology and prehistory. It is also a problem that applies to the Soan Valley chopper/ flake tool tradition of northern Pakistan that was first claimed by de Terra & Paterson (1939), and accepted as such by many since then. But, as Stiles (195) has pointed out, at least some of these are likely to represent geological flaking rather than intentional modification by hominins. This controversy has been thoroughly discussed elsewhere in this book.

The second problem is one of establishing a secure geological context for a particular find and dating those finds that can be assigned a secure geological context. Almost all the lithic material

collected by de Terra & Paterson from the Soan Valley and elsewhere in northern Pakistan came from erosional surfaces, and thus cannot be assigned a precise geological context. This deficiency has, however, been removed to a great extent by Dennell and Rendell of the British Archaeological Mission to Pakistan in the case of the collection of stone tools which they made from a stratigraphically secure geological formation in Pothwar (21).

The underlying problem for expecting the antiquity of Pothwar finds by some quarters, it seems, is the difficulties it creates in setting these finds in the overall picture of the colonization of Asia by hominins: longer chronology was often indicated but shorter chronology was hoped for. This would fit in the prevailing visualization of human origins and dispersal. If these dates are accepted, it really opens up the Pandora's box and necessitates a thorough revision of the currently accepted version of human prehistory in Asia. Recall that the earliest dates for the presence of hominins in Asia (supposedly Homo *erectus*) does not go beyond 1.6 million years ago. How, then, one reconciles this date with the Pothwar findings?

Robin Dennell has tackled this issue with some interesting observations and a radical proposal. He proposes that Homo *ergaste*r (or its Asian counterpart, Homo *erectus*) may not be the first hominin to leave Africa, that other hominin species (such as Homo *habilis* and *australopithecus)* may have migrated to Asia as they did over a large area within Africa, that Homo *erectus* or the grenus *Homo* did not have the monoply for making and using chipped stone tools, that other species of hominids are known to make and use such tools, and that the Oldawan type simple tools discovered in the Soan Valley of Pothwar Platreau in the north of Punjab may have been chipped by such preHomo hominids. As the dates of the presence of hominins in Asia is being pushed to as early as 1.8 million years in Indonesia, Georgia, and China, the work of Dennel et al has started to look more and more credible.

Dispersal of Modern Humans in South Asia: The problem of the initial peopling of Pakistan by modern humans, or of South Asia generally, hinges on the answers to several extraneous questions, the most important being: Where, when, and how did modern humans first appear in Eurasia as a whole? If modern humans first appeared in Africa and from there they dispersed to Eurasia, as is generally believed, then how did they disperse to reach South Asia? What routes did they take and in what way they interacted with other bands of their fellow humans? Some aspects of these questions have already been discussed in the foregoing pages, the following remarks complement that discussion and outlines a very rudimentary and simplistic picture which is being gradually colored with genetic data recently made available through increasingly sophisticated investigating Some informed speculations, based studies, have already been touched upon in Chapter III.1. from which a few salient features are repeated here. One should, however, keep in mind that this picture of human bands migrating from place to place and colonizing the empty land is very simplistic description of human dispersal. The genetic evidence does not provide us any 'routes' of techniques. on genetic migration; the data only tells us about the genetic interaction of different population groups and their timings. Most important of all, this visualization is completely dependent on the acceptance of the Recent Out-of-Africa hypothesis, which may or may not represent a reality.

The human story, as is generally told by anthropologists and more recently by geneticists, begins in Africa, somewhere in the high grasslands and wooded slopes of present-day Ethiopia, Kenya, and Tanzania. We are told that more than 100,000 years ago, probably more like 150,000 years ago, a small group of humans lived in this region. They gathered nuts, fruits, and seeds from the countryside. They hunted small animals and scavenged meat from the carcasses of larger animals

killed by other predators. They looked much like people today, with high foreheads, sharp chins, and light, gracial bodies. Many other types of humans lived elsewhere in Africa, Europe, and Asia, probably including the Pothwar region, Peshawar Valley, and lower Sindh in Pakistan, at that time, but they were noticeably different from these 'modern' men. Their forehead probably slanted backward toward a low, bunched skull, and a heavy visorlike ridge protruded from just above the eyes. These people would never have passed as what anthropologists now call the physically modern man, Homo *sapiens*.

Some 60,000-70,000 years ago, a small band of these modern people crossed the Red Sea into Yemen and started to disperse eastward along the rim of the Indian Ocean, traversing, generation after generations, Arabia, Oman, Iran, Pakistan, India, all the way to the 'orient' and ultimately to Australia on one hand and Korea and Japan on the other. This human migration along the coastal areas is predicated by various reasons, one of which is the extreme cold in the North at that time.

The migration of modern humans was evidently gradual and most likely punctuated. As described earlier, in Chapter III.1, one noticeable pause probably occurred around the present-day Persian Gulf area which was then a collection of freshwater lakes fed by various rivers of Iraq and Iran. Some of these migrating bands apparently stayed here for an extended period of time, probably of 10,000 to 20,000 years duration, during which they multiplied and mutated into more than one genetic lineages. In the meantime, some 50,000 years ago, the climate changed and the movement of humans to the North became possible. It is during this time that a band of humans migrated to the area which is now Syria and from there to the Levant. These people later became the ancestors of the Europeans. Other bands started moving northward into northern Iran, Afghanistan and eventually to Central Asia, reaching the Hindu Kush and the Pamir ranges some 40,000-50,000 years ago.

As the above-described migration into the interior Asia was taking place, the coastal migration to the East continued. The Indus Delta may have provided some of these migrating humans with another opportunity to take a side route northward along the Indus basin to populate the livable part of Pakistan. The peninsular India, however, provided them a greater opportunity to flourish in a much more productive environment, multiply in abundance, mutate into several clans, and taken to dispersal into the interior through the various river basins crisscrossing this vast land. Some of these populations also spilled over into southern Pakistan and intermixed with the already existing populations of modern men in the Indus Valley. Similarly, the expanding populations in northeastern plains of the Indus Valley spilled over into India through a narrow corridor skirting the foothills of the Siwalik and furnished their genes to the populations of northern India. Periodically contracting and expanding, the Thar must also have provided the population groups inhabiting at the fringes of the Desert with some opportunity to interact and exchange their genes. A better chance of getting together was, however, provided by the topology around the Indus Delta. These genetic interaction most likely took place some 50,000-60,000 years ago but their results are still observable around these points in the form of common genetic heritage compared to the rest of the borderline area. This general scheme for human dispersal in South Asia is supported by a slew of genetic, and archaeological discoveries in Africa and Asia, although the general chronology differs on the type of evidence employed. Here we mention only a few.

Fossil Record: Hominin fossils relevant to the initial human colonization of the Indian subcontinent are not particularly strong. The only known pre-modern fossil in the subcontinent was recovered from the central Narmada Valley, at Hathnora (177). The taxonomic status of the calvarium is still

disputed. It was originally classified as *Homo erectus* by its discoverer, but later identified as 'archaic *Homo sapiens'* (156). Geological, palaeontological and archaeological data suggest a late Middle Pleistocene association of the fossil, with an age of 236,000 years ago (178), though recent research indicates a potential age of 160,000-85,000 years ago (179). Re-evaluation of the calvarium indicates shared morphological traits with *Homo heidelbergensis* and *Homo erectus,* though it may be best classified as an indeterminate form of *Homo* (178).

In 2001, Rajendran, a teacher in the Department of History of Kerala University, found a complete fossilized human baby skull in Odai in the Villupuram district of Tamil Nadu. Rajendran was excavating a trench which had microliths in the upper levels and upper palaeolithic tools at the lower ones. At a depth of 6 m, Just under the upper palaeolithic deposit, there was a ferricrete deposit (a mineral conglomerate consisting of sand and gravel, cemented into a hard mass by iron oxide). The skull was found close to this trench, embedded in a similar ferricrete deposit which was later dated 166,000 years ago, placing it in the middle or upper Pleistocene.

The most secure fossils identified as *Homo sapiens* are in Sri Lanka, where partial skeletons have uncalibrated radiocarbon ages of *ca.* 31,000 years ago in Fa Hien Cave and 28,500 years ago at Batadomba-eIna Cave. This is supported by the recovery of fragmentary *Homo sapiens* skeletal evidence in the Jwalapuram Locality 9 rockshelter in southern India, dating to 17,000-10,000 years ago. There is clearly a wide chronological gap between the archaic Narmada hominin and the fossils of Homo *sapiens* that date to the latter part of the Late Pleistocene.

In 1966, Louis Dupree discovered a fragment of a right temporal bone at the cave site of Darra-i-Kur in north-eastern Afghanistan. The deposit in which it was found gave a radiocarbon date of 30,000 ± 1900-1200 before presen, i.e, 28,950 ± 1960-1235 BC. The fragment was considered consistent with Neanderthals as well as anatomically modern humans. The associated stone tools seem to belong to a middle paleolithic context. No human fossil has been discovered in Pakistan.

The Paleolithic Record: We have noticed in Chapter III.1. that in the Late Pleistocene, *ca.* 35,000-40,000 years ago, especially in Europe and West Asia, a qualitative change in the technologies of stone tools manufacturing and a much more sophisticated choice of raw materials for making them occurred. To some archaeologists and anthropologists, it appears as though a new human, a ‘modern man’, had descended on the scene or the existing inhabitants had started to experience a radical evolution, even a revolution. We find the existence of this ‘modern man’ around lakes, along the sea shore, and along the banks of small rivers. The cultural, technological, and social progress in human condition was particularly rapid after this point and ultimately it lead to the development of agriculture and domestication of animals in the Fertile Crescent *ca.* 10,000 years ago. The arrival of the modern man in Europe is also reflected in the abstract thinking, such as religious connotation in the practice of burying the dead. Such an identification mainly takes into account the European evidence at the peril of the rest of the world. In this sense, it is a purely Eurocentric point of view and does not necessarily apply to South and East Asia.

No technological and cultural revolution, comparable to that of Europe and West Asia is, however, evident from archaeological remains of the Late Pleistocene in Pakistan and neighboring regions of India, Afghanistan and Iran. We do notice the development of some new tool-making technologies in the arid zone of Pakistan, especially in Sindh, but these technological changes occurred rather gradually and sporadically. Our major evidence for the emergence of modern man in Pakistan and

the surrounding region comes from genetic research although we repeatedly turn to the stone tools to confirm our findings. In general, the correlation between the genetic data and the stone typology is not good and we are not able to trace the path of the modern man in the Indus Valley and the surrounding hills to our general satisfaction.

The evidence for the advent of modern man, as judged by the advancement of the traits which are commonly cited as evidence for modem human behavior, is relatively sparse in South Asia (180). Though certain traits may extend as far back as the Acheulean, the clearest and most reliable evidence for symbolic thought and the construction of structures dates to *ca.* 30,000 years ago and younger, a time period that we commonly refer to as the Mesolithic. A range of novel technologies, including the microliths, are noticeable but we do not really know their point of origins. Stone tool assemblages show increasing diversity, characterized by the production of blades and burins. However, these so-called Upper Paleolithic industries are not as common as they are in Europe. There is contemporaneity between flake- and blade-based technology and microlithic industries, suggesting that a 'Late Paleolithic' label may be more appropriate to characterize the unique character of the South Asian industries rather than the European parallel of Upper Paleolithic. These sites are common in Sindh, generally around lakes, which are now dry or brackish. A large number of similar sites have also been found in India. Despite this collective evidence for changing technologies, we do not detect any sign of a sudden cultural change, neither we hear the faintest sound of the trumpet announcing the arrival of ‘modern man’.

Genetic Evidence: Genetic studies is another anchor onto which we tie our hope for resolving this matter. They seem to be more ‘scientific‘ and they have thus acquired more credibility. A large number of such studies are available and all of them employ the concept of genetic tree, implicitly advocating a physical migration of modern humans out of Africa, multiplying among themselves and replacing all traces of the pre-existing humans all over the known world.

Phylogenetic patterns from both mtDNA and the Y chromosome data support the colonizaand the Y chromosome data support the coloniza 70,000 years ago. The same data also point to Africa as their point of origins (34,155,156,103,22). As indicated earlier, South Asian lineages belong to mtDNA haplogroups M and N (groups U and R being major subclades of N), which are descended from the L3 haplogroup from Africa. The coalescence dates for haplogroup M (specifically U2i, M2, R5) in South Asia average between 73,000 and 55,000 years ago, and may represent an Indiaspecific subclade related to the original dispersal event into the subcontinent (97). These early coalescence dates are supported by those obtained from the Andamanese M31 and M32 and Malaysian M21 and M22 lineages (23,181). The geographic origin of the M lineages remain uncertain, and as indicated above, include suggestions for a Southwest Asian origin (181,137). DNA evidence raises the possibility that L3 populations dispersed from Africa, reaching geographic areas along the Indian Ocean rim by 100-80,000 years ago (182) .

An Emerging Temporal Horizon: Following the genetic trail of various mtDNA and Ychromosome Haplogroups in Iran, Central Asia, and India, early researchers came to the conclusion that modern humans was not present in Pakistan and India before 45,000 years ago. These estimates were obviously meant to strengthen the mainstream paleoanthropological dogma that Europe was populated by modern humans *ca.* 50,000 years ago and thus the first entry of modern humans into Pakistan and India could not have been earlier than that.

Some recent genetic studies, to be sure, extended this time line as some coalescence dates do go as far back as 70,000 years ago. This still does not resolve the issue since even these early dates do not explain the discoveries at Jebel Faya and South China that go beyond 100,000 years ago. As a consequence, some researchers, like Petraglia et al (76) have recently come up with dates that fall between 130,000 and 70,000 years ago and it is now generally agreed that the modern humans existed Africa some 140,000 years ago, carrying a 'Middle Paleolithic artifactual package' with them, which technology they spread throughout Asia (as opposed to the earlier conclusion that modern humans exited Africa after 70,000 years ago with the Upper Paleolithic package).

In this scenario, the introduction of the Upper Paleolithic to Europe must be sought somewhere else. Furthermore, in order to keep the thesis of Recent Out-of-Africa and Replacement model intact, we must assume that Europe was colonized by modern humans later than South Asia. The role of the Persian Gulf Refugium, discussed earlier, could be a partial way out. Once we have unhinged the Later Stone Age of South Asia from the Upper Paleolithic of Europe, we will be in a better position to discuss the emergence of modern man in Pakistan and India somewhat more rationally.

Discontinuities in Inhabitation: A discontinuous colonization of 500,000 years of Europe by early humans has been proven. A similar situation is indicated in the Stone Age Pakistan. There has been some evidence from Pothwar where long periods of time seem to be without any sign of human occupation. The same type of evidence has been cited from the Peshawar Valley, which showed periods of drastic decreases in hominin population as well as noticeable increases in other times. For example, there are unmistakable signs of increased human occupation around the Sanghao Caves, as judged from increased number of stone artifacts, during a time period when archaeologists have noticed a severe decrease in population in the Pamir Knot area, an outright out-migration, or even an extinction. The evidence coming from the dry zone of upper Sindh, at the western peripheries of the Thar Desert, is even more clinching although the reasons for out-migration, extinction, and repopulating may be different.

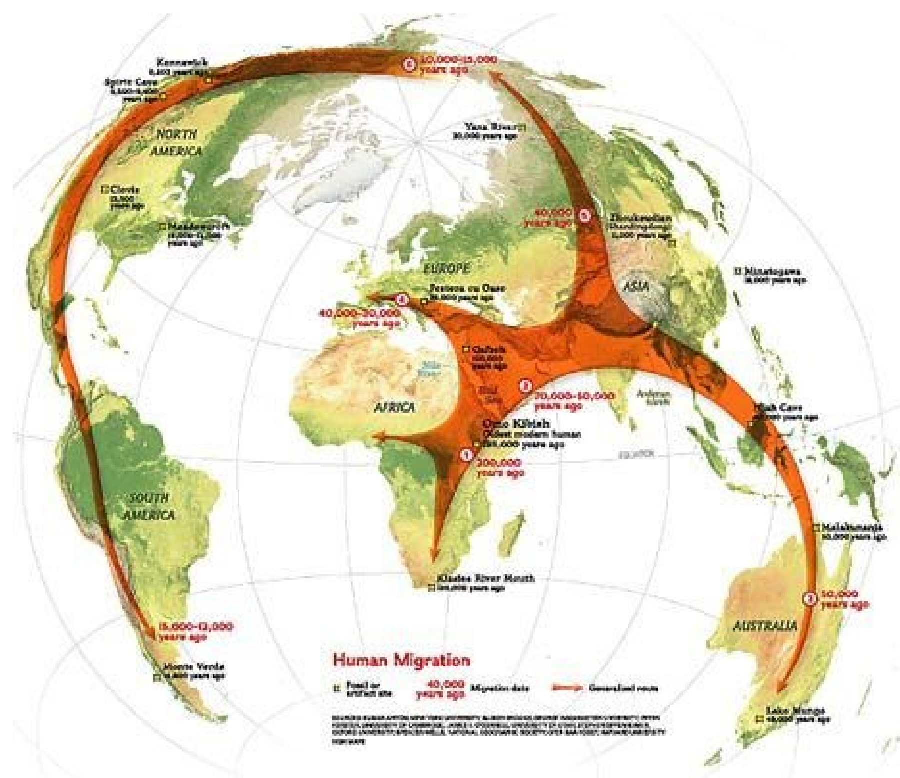
Population extinctions, out-migrations, and re-populating obviously have had far reaching cultural consequences in the affected regions. For example, the Middle Stone Age people who repopulated the arid zone in the wet phase after its long term abandonment in the dry phase, brought with them their own tool making traditions. Since the upper Paleolithic techniques all over the subcontinent largely evolved locally from those of the Middle Paleolithic towards the end of the humid phase, the Late Stone Age tools of the arid zone got differentiated from the neighboring areas in the East where such a discontinuity in human population had not occurred. The visible differences between these artifacts and those from peninsular India has its origins in the discontinuity of human occupation of the dry zone.

Colonization, abandonment or extinction, and recolonization were obviously predicated on climatic conditions and other environmental factors. When conditions were favorable, humans (and their predecessors) dispersed into and often colonized new areas or re-colonized ones previously abandoned. As conditions deteriorated, the limits of human settlement contracted; some areas were abandoned, and doubtless many populations became extinct. In Europe, the main climatic variables affecting hominin populations were winter temperatures and rain/snowfall. In Pakistan, where ice sheets were never as extensive, the main climatic variable, the availability of water, determined the colonization of new areas, and their opposite conditions of abandonment and isolation. For the most part, early humans danced to the rhythms of Pleistocene climatic change. However, their responses

were not unchanging like those of other animals, because humans evolved, and their behavioral capabilities developed. Hominins 0.5 million years ago were undoubtedly more competent than their counterparts a million years earlier, and modern humans were even more competent at 35,000 years ago. Thus conditions that might have been insurmountable for hominins at 500,000 years ago were coped with 50,000 years ago because of improvements in hunting, gathering and food-processing techniques, clothing, shelter, the use and control of fire, the ability of humans to procure raw materials over great distances, improvements in their communication skills (especially language), as well as in their cognitive awareness of their social landscapes. Thus the Pleistocene humans record of South Asia can be seen as a game between the vicissitudes of Pleistocene climatic change on the one hand, and their gradually developing survival skills on the other hand.

Routes of Expansion : Whatever the timing of the dispersal of Homo *sapiens* in the subcontinent, the route or routes of human dispersal in South Asia and beyond remain controversial. The main question is: Did modern humans arrived Pakistan from the West through a coastal route or through a terrestrial route? In other words: was the interior of this land populated by humans who came through the coastal south and then gradually moved northward along the river Indus and its tributaries, or did they come from the Northwest (the Pamir Knot?), gradually descending southward?

Typically, the dispersal route of Homo *sapiens* is represented by a broad arrow that sweeps north-eastwards out of Africa, which then bifurcates into sub-branches that enter Europe, Siberia, and the northern portion of South Asia.This schematic is purely illustrative and is not the product of either paleogeographical or paleoenvironmental analysis. Within this scenario, several possible routes of dispersal have been proposed on scientific grounds but increasingly the weight of archaeological and genetic evidence is falling more and more on the



A pictorial representation of the spread of modern humans across Eurasia, showing the central position of South Asia in this dispersal. Such a route is purely illustrative, and is not the product of either paleogeographical or paleoenvironmental analysis.

side of the so-called *southern coastal route*. According to this hypothesis, the modern humans would have traced the coastline of the Arabian Peninsula, crossed the Persian Gulf region (which was most likely a collection of freshwater lakes during that time), traversed along the coast of Makran, and continued moving along the coast of peninsular India. The descendants of these people would have ultimately colonized Australasia and Island Melanesia by *ca.* 60,000 years ago. The large number of sites across East Africa, the Arabian Peninsula, Sindh and Lasbela in southern Pakistan, and Narmada Valley in Southwest India are broadly attributable to the Middle Paleolithic which also hint at the potential for human dispersals through these areas (64,76).

These matters have already been discussed in some details in Chapter III.1; here we focus on the occupation history of human populations in South Asia, more particularly in the Late Pleistocene. We shall consider the genetic and archaeological data, followed by the results of GIS modeling of human spread. Since almost all reviews on the dispersal of modern humans in South Asia are based on the Recent Out-of-Africa and Replacement hypothesis, with a complete neglect of the Multiregional or Assimilation theory, all accounts, whether archaeological or anthropological, and now genetic, appear to be somewhat advocative. To some extent, it is understandable: an immense amount of literature has accumulated in the past several decades and this is not easy to ignore. Furthermore, a large number of academicians owe their living to this advocacy as it does not pay well to swim against the current.

GIS-Based Model for the Expansion of Modern Humans in Pakistan: The archaeological and genetic arguments for the so-called southern coastal route for the expansion of modern humans in South Asia have already been presented in the above as well as in Chapter III.1. and summarized in the above. Here we take notice of the GISbased model of Field, Petraglia, and Lahr (117,118), that clearly leads us to a southern entry. Their studies also examined the environmental conditions that may have affected subsistence, migration speed, and demographic expansion, had this route been employed in prehistory. (GIS stands for a computer program: Geographic Information Services). They cover a time period of the OIS 4, which translates roughly the time interval between 50,000 and 70,000 years ago. They distinguish between two types of migrations or dispersals': direct coastal migration and 'wandering dispersals. The former is the major human migration from west to east, in this case along the coast of the Indian Ocean. The later are the terrestrial migrations, away from the coast but generally along the rivers and through the river valleys, generating a set of indirect, wandering, *terrestrial* routes. It is, thus, the combination of the two modes of population expansion in South Asia, including Pakistan.

These researchers highlight the attractiveness of South Asia to coastal foragers, and take into consideration the environmental conditions that may have affected subsistence, migration speed, and demographic expansion, had this route been employed by Homo sapiens to reach South Asia. They also suggest that portions of the route through this region would have compelled populations to move inland. Additionally, they suggest that the presence of the Ganges–Brahmaputra delta would have served as full or partial barriers, keeping populations of the present-day India more or less within the confines of the peninsula and encouraging expansions into the interior. By the same token, it is



Hunting was important but in their dispersal humans were probably more dependent on aquatic sources than on hunting or foraging

suggested that the presence of the Great Desert, the hTar, and the Indus Delta would have served also as an effective barrier, keeping the population west of the Thar bottled up within the Indus plains and encouraging it to expand northward, most likely along the Indus through its western tributaries. The genetic studies that indicate reduced gene flow between India and the surrounding regions lend support to this hypothesis (97). More recently, Qamar and coworkers and Quinta-Murci et al have further strengthened this conclusion by genetic mapping of Pakistan's populations and compared the data with those of India in general. These studies will be discussed in some details in the next Section.

As a starting point, Field and associates assessed the potential of modern man for entry into South Asia via a northern terrestrial as well as a southern coastal route by assuming that the first

modern humans to enter South Asia were mobile hunter-gatherers, and in addition to hunting large game animals in a variety of terrestrial environments, they were also familiar with coastal resources and marine foods. This assumption stems from research in the African Middle Stone Age (13,183) that documents a generalized subsistence system that includes coastal organisms such as shellfish, fish, sea lions, and small rodents, as well as larger prey such as bovids and antelope. These findings imply that coastal resources, and perhaps more specifically aquatic resources such as fish and

shellfish, may have encouraged dispersals via the coasts as well as along river valleys.

In this study topography is the primary controlling factor for dispersals, although the extent of other geographic features such as extents of sand, seas or water gaps, also serve as barriers of dispersal routes. The model anticipates that modern human populations would have encountered other hominins,

most likely Homo *heidelbergensis* or their descendants. Dispersals into the interior zones of the subcontinent undoubtedly put these two populations in direct competition with one another, perhaps in a similar fashion to the expansion of modern humans into Neanderthal dominated Europe *ca.* 40,000 years ago.

Overall, this model suggests the manner in which modern human populations may have circumscribed and infiltrated South Asia, and ultimately expanded demographically to fill the subcontinent. Regions that would have served as corridors or barriers, or areas that would have been attractive in terms of fauna, water, or lithic resources have been identified and discussed in relation to archaeological chronologies, artifact assemblages, and modern human diversity. The researchers compared the archaeological record of South Asia with this model and discussed the implications of the relationship to chronologies and prehistoric trends from a few specific areas. We shall dwell a little on this important study. Our treatment will necessarily brief, for details, the reader is encouraged to read the original papers (117,118).

Field's GIS Model and Assumptions: GIS (Geographic Information Service) is now a standard tool in archaeology for modeling and elucidating a number of phenomena related to past environment and their influence on the inhabitation of regions of interest by humans and non-humans (184). A geographic information system (GIS) integrates hardware, software, and data for capturing, managing, analyzing, and displaying all forms of geographically referenced information. GIS allows us to view, understand, question, interpret, and visualize data in many ways that reveal relationships, patterns, and trends in the form of maps, reports, and charts. GIS is most often associated with a map and it can provide a great deal more problem-solving capabilities than using a simple mapping program or adding data to a mapping tool. Additionally, GIS is a set of information geographic combining data and applying some analytic rules, one can create a model that helps answer the question one has posed. Thus, by utilizing these modeling techniques and by proposing various propositions, rules, and restrictions, the GIS-based methodologies can examine the likeliest routes for human dispersals.

Field and associates examined the dispersal of modern humans and their colonization of South Asia in Oxygen Isotope System 4 (OIS 4) that spans between *ca.* 60,000 and 70,000 years ago, a time period that is traditionally thought to be associated with the expansion of modern humans in Pakistan and India.They utilize a very simple set of assumptions for their analysis, some of which are as follows:

1) The migrating populations generally followed the “easiest”, or “least costly”, route across linear course of travel through a physical landscape, which includes the crossing of flat plains, river banks, or at times crossing of mountain passes.

2) The fist modern humans to colonize South Asia were mobile hunter-gatherers, and these groups may have relied upon, or at least been familiar with, subsistence strategies that included coastal

resources.

3) Montane environments and resources were undoubtedly important to early colonizers; however, when considering human dispersals these regions are less likely to have served as major routes, as they are more costly to hunter-gatherers in terms of energy expenditure, and less attractive in terms of the availability of game and collectable foods.

4) The most favored routes, therefore went along coastlines, plains, and river valleys, and more generally on corridors that connect the interior of Pakistan and India with the coasts. transformation datasets from tools that derive new

existing datasets. By 5) During the glacial conditions of OIS 4, riparian areas that would have provided water and habitat for a variety of animals would have been most attractive to hunter-gatherers. To this end, riparian areas that flank major rivers were the most favorable areas to migrate into.

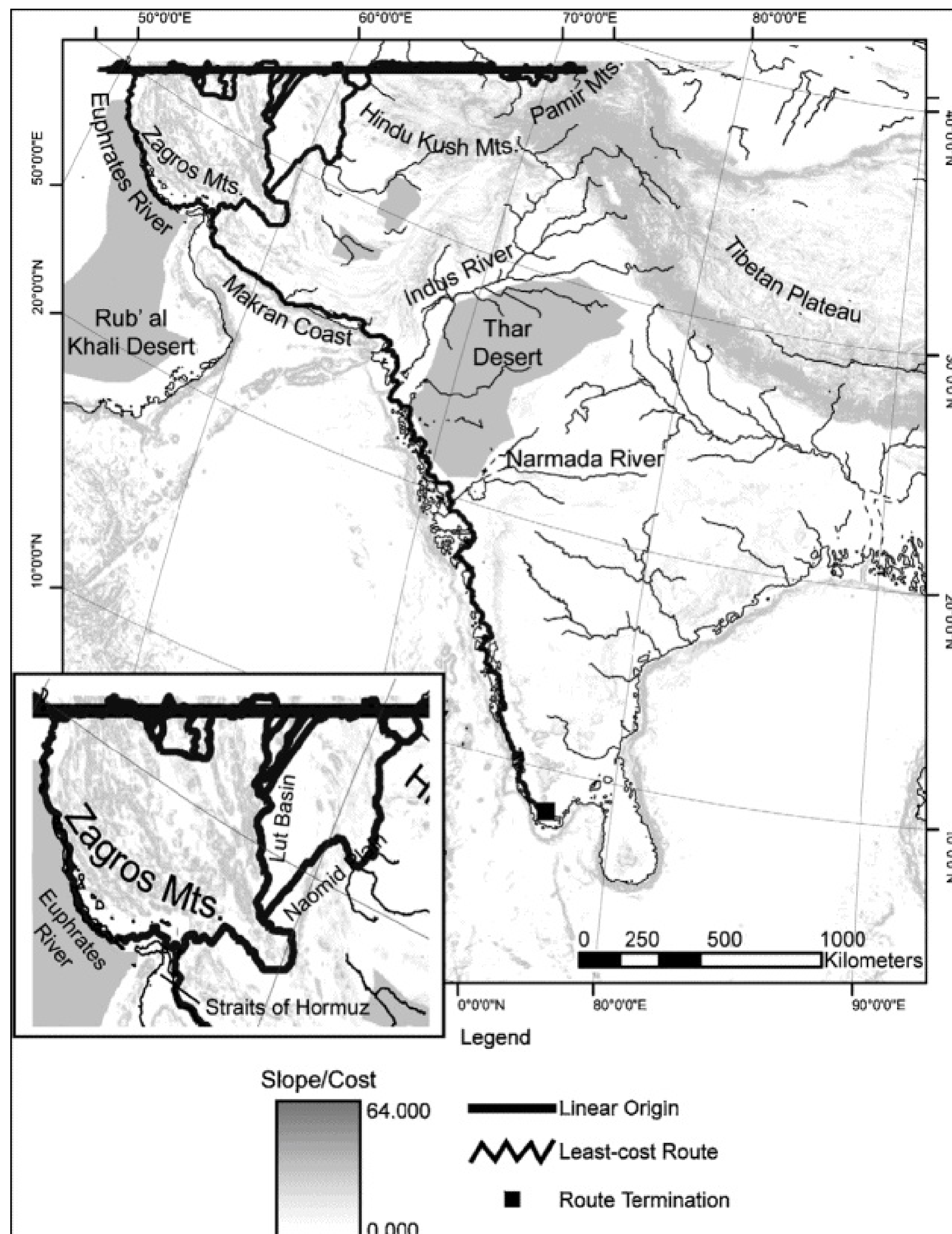
The study under discussion employs two discrete analyses: a ‘direct route’ analysis and a ‘wandering route’ analysis. The *direct route* analysis examines the most parsimonious route into South Asia from points to the west; the *wandering route* analysis aims to produce hypothetical routes within South Asia that were not driven by a destination, but would have led to the distribution of human populations in different regions, and perhaps at different times. Both of these analyses rely upon a least-cost algorithm housed within the GIS software.



A view of the Makran coast near Ormara in Baluchistan, poor in vegetational sources but quite rich in fish and other aquatic food

In the direct route analysis, an expansive ‘origin’ “that lies to the west of South Asia” was used to simulate the entry into South Asia. This “origin” may have been the result of either a northern terrestrial route (the so-called Northern Route), or a southern coastal route (the so-called Southern Route) to exit from Africa: to simplify the matters, the model is rather neutral in this regard. “It should be noted that the model sponsors neither a southern point of exodus from East Africa nor a northern migration point from the Nile Refuge. The model only stipulates the existence of modern humans anywhere in the west of South Asia which were ready and eager to disperse in any direction into their surroundings. This is an important difference from all previous attempts in mapping the dispersal of humans: all of these studies are tied up with one or the other hypothesis of African migration” (117).

In one of their studies, this "origin" was taken as a line that stretched 2200 km across nearly all of southwest Asia, from the Pamir Mountain Range that lies to the west of the Tibetan Plateau, to the banks of the Euphrates River in Eastern Arabia. This area was chosen as the origin based upon the consensus view that modern humans dispersed out of Africa, rather than a source from the northeast, such as Eastern Asia. In another study, the "origin" is taken as the area at the tip of Hormuz Straight or the Euphrates Delta. Incidentally, a number of west-east routes that were generated in the former study from the hypothetical "origin line" merged into three major routes, all three of them proceeding around the Zagrois mountains and ultimately uniting into one near the Strait of Hormuz. This is in consonance with the theory of the 'Gilf Oasis' discussed earlier in last chapter.



The end result of Field's GIS analysis, representing the main thrust of human dispersal from the

“West” to South Asia. The heavy lines depict the main or the “least costly” route, the grey areas represent the regions, the crossing of

which would have been “most costly” (117). (see further explanations in the text.)

The Main Coastal Thrust: The simulated results show that the major dispersal route emanating from the ‘point of convergence‘ near the Straits of Hormuz headed east along the Iran and Makran coast into Pakistan and then India. This does not, however, preclude the possibility that populations entered and occupied southern steppes of Central Asia, but implies that these areas were not major routes into South Asia for the bulk of the population (117). As will be shown later, such dispersal to South Asia, namely through northern Pakistan, from Central Asia did happen but these migrations were of comparatively recent origins.

The main route, namely the southern coastal route, made an ecological sense because it, along with its sub-routes, offered markedly abundant resources.The route would have crossed through riparian areas and marshes, providing an expansive environment with both water and game (185). It is likely that the region of Euphrates Delta could have adequately supported a dispersing population during OIS 4, and thus leading them directly towards the Makran Coast. Once in this region, migrating populations would have encountered an arid coastline that provided a variety of marine foods (e.g., molluscs, crustaceans, birds, and turtles) and with further travel eastwards would have reached the rich ecosystem of the Indus Delta (186).

The Figure above depicts the end result in the form of GIS generated model. First of all, the location of the ‘origin’ is shown as a long hypothetical line, representing a vast area from where humans could have started to migrate or diffuse towards the Indian subcontinent.This assumption takes away the controversy as to where the original human groups came from to India and Pakistan. For our purpose here, ‘somewhere west‘ is good enough. Second, the three main overlapping subroutes originating in the west converge at the southern tip of the Zagros Mountains. Third, the main thrust towards the East is along the Persian Gulf and then, skirting the coast of Makran, all along the Indian Ocean rim. This is the ‘least costly‘ route to Pakistan and further along to India. Note also the grey areas in the map. Any route across these areas would be ‘most costly’.

The Wandering Paths or the Routes to the Interior: The ‘wandering paths’ of the GIS model under consideration are the divergent routes that branch off the main coastal route, leading to the interior of the subcontinent along a least costly path, forced by some barriers for the main thrust and the availability of subsistence or other incentives. There are several points of bifurcations all along the Indian Ocean rim, the first being the Indus Delta and the last the Ganga-Brahmaputra Delta, as depicted in the figure below.

The initiation point for the *wandering routes* begins on the Western bank of the Indus Delta. This location was selected from the results of the direct route analysis, which passed through this region. One must realize that caution needs to be exercised in placing the wandering origin here, given that the bed of the Indus and its tributaries has repeatedly changed its course over the Holocene. The Indus Valley is an ancient riparian landscape that has been carrying outflow from the Himalayas to the Indian Ocean throughout the Pleistocene (187). It may have been one of the first of several diversions into the interior, as the river itself could have proved a barrier during OIS 4, and the flat alluvial terraces of the valley bottom would have drawn hunter gatherer populations northwards.

According to Field and associates (118), this route proceeded northwards across the Indus Valley and along the western bank of the River, eventually reaching a *cul de sac* at the foothills of the Sulaiman Range. Additional analyses from a starting point further upriver allowed for this route to continue onto the Pothwar Plateau, and end in the foothills of the Hindu Kush Mountains. This route also suggests that entry into the Gangetic Plains could have been gained via a northern route, along the foothills of the Siwaliks and around northern tip of the Thar Desert.

70°0'0"E
80°0'0"E
30°0'0"N
20°0'0"N
10°0'0"N
70°0'0"E
30°0'0"N
90°0'0"E 20°0'0"N
10°0'0"N
80°0'0"E
90°0'0"E

Thar Desert
Indus Delta
Ganges-Brahmaputra Delta
Sri Lanka
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27
0 250 500 1000 Kilometers

Slope/Cost



64.000
0.000



Potential Routes of Dispersal



Pleistocene Sites

Results of the wandering path analyses into and through South Asia. Least-cost routes are indicated by the grey lines. Costly areas, including sand seas and areas of high slope are indicated by the color grade. Inset shows detail of Cape Rama diversion (117)

Independent of the Indus Valley diversion, placement of a third origin on the southern side of the Indus Delta (which presumes that human populations were able to cross both the water and marsh barriers within the delta), generated a wandering path that continued down the coastline to the south into India. Subsequent wandering down the coast led the route to skirt the southern fringe of the sand seas associated with the Thar Desert. The route then encountered the delta of the Narmada River, which flows into the Indian Ocean just south of the boundary for the Pleistocene Thar Desert. The least cost analysis predicts entry into the interior at this point, using the Marble Rocks gorge as a corridor into the Narmada Valley. The route continued to wander along the Narmada Valley for approximately 1500 km, and then jumped into the drainage of the Son River. This leg of the wandering route terminated at the conjunction with the Ganges River.

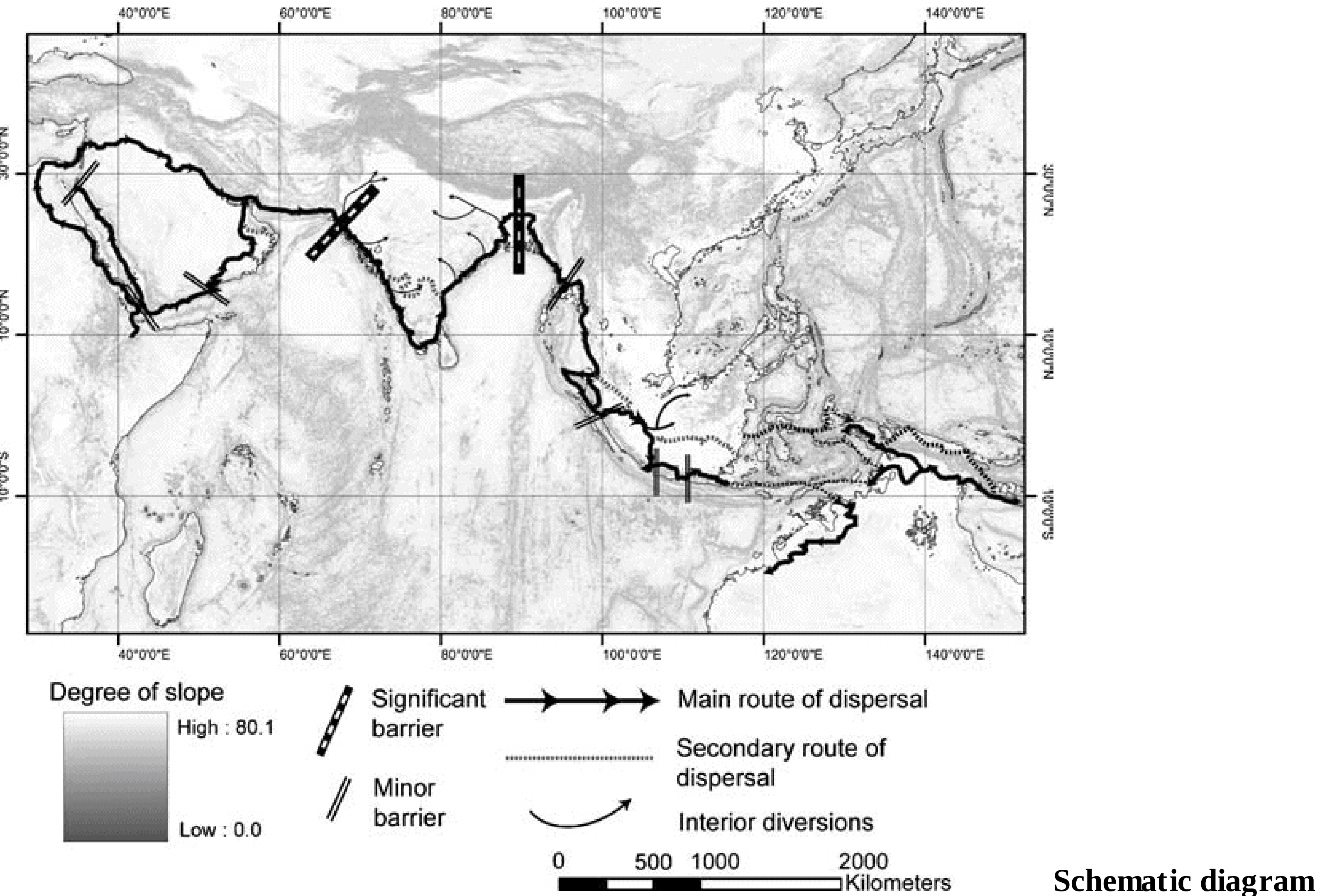
Barriers and Corridors along the Southern Dispersal Route: The results of GIS analyses for the Southern Dispersal indicate that if migrants followed the proposed route, they would have encountered a variety of climates, environmental zones, and interior as well as coastal landscapes. For our purpose, the barrier across the Indus Delta is extremely important. Continuing eastwards from the Straits of Hormuz to the mouth of the Indus Valley, migrants would have followed a completely coastal corridor. However, once migrants reached the Indus River, the corridors turn back inland. Riparian environments, coupled with mangroves or swamps that are difficult to cross, may have provided these corridors. The Ganges-Brahmaputra Delta also may have served as a barrier that deflected populations into the Ganges Valley.

In sum, the combination of corridors and barriers in South Asia implies that this region would have absorbed populations, rather than pushed them further eastwards along the coastlines. These conditions, as well as the barriers and corridors indicated in the Figure above, have marked implications for human subsistence, migration speed, and demographic expansion. The following discussion will focus on these issues, and also comment upon how the routes and their surrounding environments may have contributed to human evolutionary trajectories.

According to their assimilation for Pakistan (117,118), the initiation point for the inland dispersing ‘wandering routes’ begin on the western bank of the Indus Delta. This location represents the results of the direct route analysis, which passed through this region. The Indus Valley is an ancient riparian landscape that has been carrying outflow from the Himalayas to the Indian Ocean throughout the Pleistocene. According to the simulation employed, the ‘wandering’ terrestrial route proceeded northwards along the Indus Valley, eventually reaching a *cul de sac* at the foothills of the Sulaiman Range. Additional analyses from a starting point further upriver allowed for this route to continue onto the Pothwar Plateau, and end in the foothills of the Hindu Kush Mountains. This route also suggests that entry into the Gangetic Plains could have been gained via a northern route around northern tip of the Thar Desert, all along the foothills of the Himalayas.

The lower Indus Valley, especially the western bank of the Indus must have been a particular advantageous area for the expanding population as it provided a varied type of terrain with frequent and permanent sources of fresh water year round. The researchers take note of the subsistence

economy of the time in this region. They indicate that although increased aridity during OIS 4 glaciation would have significantly reduced the size of the Indus River, in the midst of the surrounding desert the estuary would have provided a crucial habitat for migrating birds, as well as contained fish and shellfish. Larger animals that were common to the savannas of South Asia, such as elephant, buffalo, wild cattle, deer, and rhinoceros may have been also present (196). These conditions suggest that populations could have remained in this region for longer periods, and probably expanded upriver into the Pothwar Plateau.
found in abundance in future. According to this model, the Indus Delta not only provided the first major area rich in subsistence resources but also acted as a partial barrier to a continuation of onward migration towards the East. These circumstances had three major effects: First, it provided a relatively lengthy pause to the human push along the coast. This had the effect of concentrating human population in this region and providing them with alternative routes for dispersal. Second, the increased populations in the area provided the migrating humans an opportunity to genetically homogenize through exchange of genes between different demes (between different bands of hunter-gathers) on one hand and emergence of some Indus-specific



Schematic diagram of potential routes of the Southern Dispersal. Parallel bars indi

Fig. 14. Schematic diagram of potential routes of the Southern Dispersal. *Parallel bars* indi)
cate the locations of barriers, while *arrows* indicate diversions into the interior.
Archaeological evidence is, however mea

markers on the other hand. Third, the presence of this partial barrier would have served to keeping populations of Pakistan more or less within the confines of the Greater Indus Valley and encouraging

expansions into the interior all along the Indus River and its various western tributaries. This inland expansion may have been one of the first of several diversions into the interior of the Asian continent. These researchers also highlight the attractiveness of the Indus Valley to coastal foragers.
It is also suggested that the presence of the Great Desert Thar would have served as another effective barrier, keeping the population west of the Thar bottled up within the Indus plains and to a large extent inhibiting genetic intermixing with the population groups t h a t m a y h a v e a l r e a d y

cate the locations of barriers, while arrows indicate diversions into the interior. (118crossed over and by now have

populated the Indian Peninsula. By the same token, the population within the Indian Peninsula remainedbarriers in South Asia implies that this region would have absorbed popu

ger, most probably because of lack of Paleolithic bottled up more or less within the confinement oflations, rather than pushed them further eastwards along the coastlines.

research in this area or because of the overlain the present-day India. Genetic studies that indicateCrossing the Ganges-Brahmaputra leads to additional corridors that
sediment, hiding any sign of habitation if there was reduced gene flow between peninsular India andrun southwards, with perhaps a minor barrier at the Iriwadi River. Popula
any. These favorable areas extended all the way to the surrounding regions lend support to this hythetions that were blocked or slowed by this delta may have traveled south
where Middle and Late Pleistocene Pleistocene pothesis (49). For example, Qamar and coworkers wards by boat or raft to the Andaman Islands from this point. Further
artifacts have indeed been found in relative abunand Quinta-Murci et al have recently shown thatsouth, the migrants faced a difficult route southwards into Sunda, with al
dance (197). The site 55, dating to 45,000 years is there has not been much gene flow between theternating coastal and inland corridors, while crossing into Wallacea im
important in this regard. Dennell and colleagues populations living on either side of the Thar Desert,plies a familiarity with boats and coastal conditions. Two potential routes
document the presence of stone blades at the site, namely, between Sindh and Punjab on one handof dispersal have been identified: one from the south that eventually endsand central and south India on the other. Theseand also suggest that the activities included habitastudies will be discussed in some details in the nexttion onto the western Australian coast; the other through the northern Mollu

and lithic procurement in the high foothills cas and into northern Sahul. However, once Sahul was reached reliance(198). Although the high rate of sedimentation has Such a scenario has some support from on coastal travel may have again been reduced, as corridors again turned
resulted in a poorly known Paleolithic archaeologigenetic data that suggest lineage divergences ininland. This is also true of the northern coast of New Guinea, where
cal record for the rest of the Indus Valley, Field et al South Asia *ca*. 44,000–63,000 years ago, as well as analyses suggest that migrations would have had an easier route into the
(117) hypothesize that other sites are likely to be archaeological evidence for increasingly modern

behaviors after this time period. However, the genetic data presented in the next chapter would also show that population groups moved not only along the rivers but also from valley to valley. In this respect, Pakistan served as a major corridor for the dispersal of modern humans to India and beyond.

In addition, the fact that the Indus Valley is flanked by the Thar Desert on the East and the mountains of the Sulaiman and Hindu Kush ranges in the West implies a degree of genetic isolation for these populations. This is partially true. While such an isolation, although only partial, is indicated with the eastern side (India), the impediments of the mountain ranges in the West seem to have little effect. The networks of exchange and interaction may have episodically moved people and materials out of or into the region on the western side while such a possibility with the East was limited.

In summary, the least-cost approach in this model is explicit in confirming that modern humans dispersed in OIS 4 timeframe through the southern coastal route, combined with expansions through certain inland corridors, such as that represented by the Indus Valley. What is known about the paleoenvironment of ancient Pakistan suggests that both the coast and the interior would have been attractive to mobile parties of modern hunter-gatherers. If the use of coast and riparian corridors allowed for rapid dispersals into the Indus Valley, and movement between these environments was not a problem in terms of subsistence and subsistence related technologies, one could safely suggest that populations could have expanded rapidly into the heartland of Pleistocene Pakistan along river valleys while the main thrust out Africa towards Australia remained along the Indian Ocean rim.



Terrestrial Route: A terrestrial route from East Africa to the Levant, all along the Nile and across the Sinai, and then to Central Asia, Pakistan, and India has also been proposed and there is a stark divide between those who believe

that early humans mainly migrated along the sea shore and the river banks (92) and those whose research leads them preferably to land routes. The climate in the north during OIS 4 was too adverse as to make any human venture away from the coast difficult, if not impossible, during this glacial time. However, it is very well possible, and in some instances probable, that humans did disperse in South Asia through a land route during OIS 5, when the climate was somewhat milder. This particularly applies to the situation in Pakistan where genetic evidence is at hand and which clearly indicate some human dispersals through central Asia. Oppenheimer (101) identifies one such North-to-South terrestrial migration to Pakistan with the lineage L(M-20) which, according to him came from the area commonly known as the Pamir Knot.

This lends support to Korisettar's (199) suggestion that early human populations would have found accessible transcontinental routes, traveling through the Hindu Kush and Sullyman passes through the

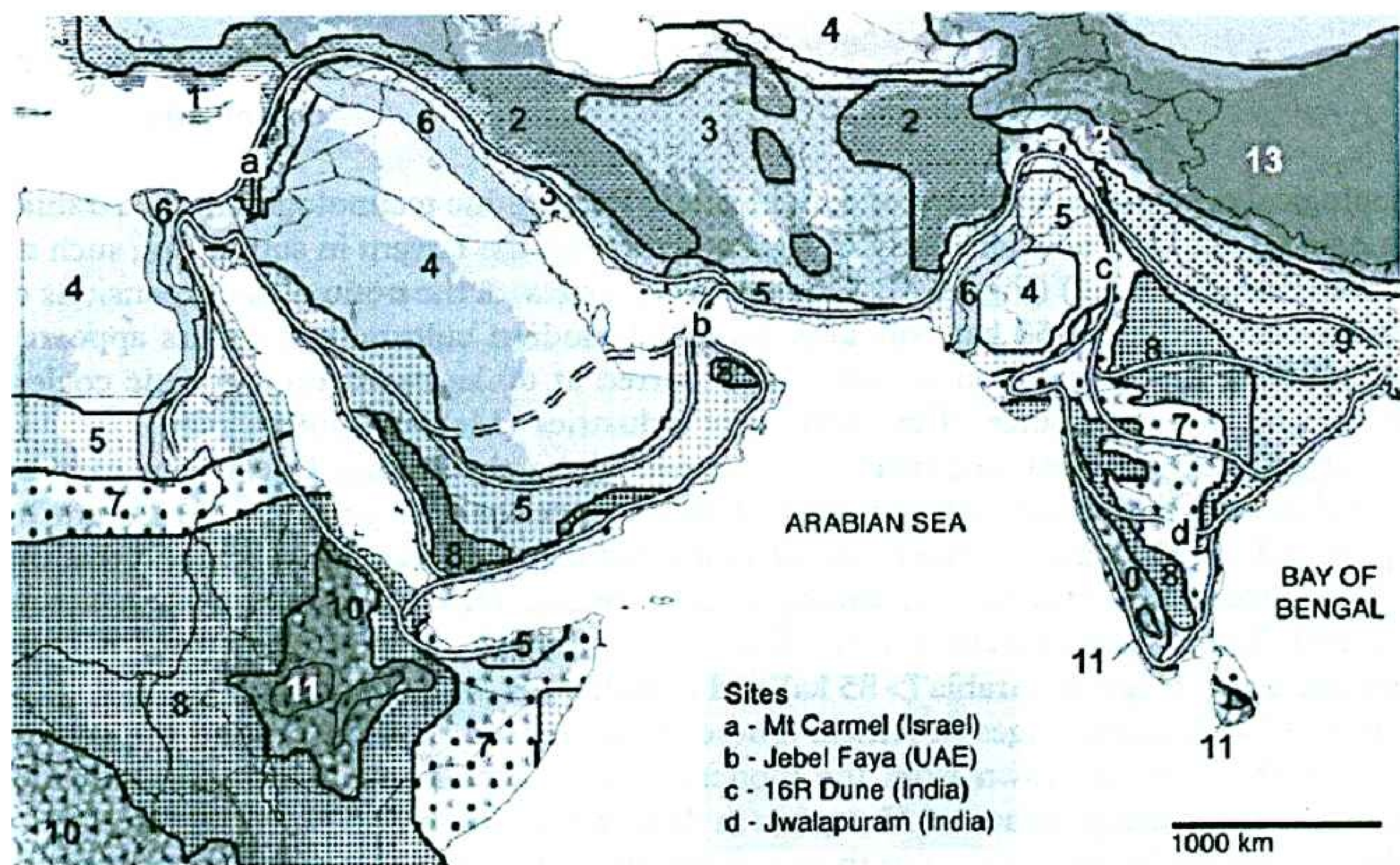
norther Indus Valley to the interior basins of the Indian peninsula. In this view, transcontinental routes and the wide distribution of river valleys and basins were more conducive than coastlines to human population movements owing to the presence of reliable freshwater resources (in the form of lakes, streams and springs), lithic resources and varied woodland and grassland eco-zones with a high concentration of animal communities. In this model, occupation in the geological basins was especially attractive during periods of heightened climatic aridity.

A strong genetic connection between the present populations on either side of the Divide is known and has been repeatedly shown in recent mtDNA studies. Whether this genetic affinity has a deep rooted origin or it is a product of later intermixing is not known for certainty but some studies have indicated both. If a deep rooting connection is presumed, it can be explained through an initial migration from the north of Punjab, along the foothills of the Siwaliks, into the Divide and further along into Ganga-Jamuna plains. This genetic signature is further strengthened by a similar migration, along the Hakra-Ghaggar river system, again, into the Divide and merging with the former wave from northern Punjab. This is speculative stuff but it does make a lot of ecological sense.

It must be understood, however, that these human dispersals were of late origins and they in no way define the initial colonization of Pakistan. These dispersals are also of secondary nature as we do not detect any discontinuity in genetic material as we travel from the north to the south. Human migrations from central Asia have been a constant feature in the prehistory of Pakistan and their genetic signatures are hard to decipher for repeated gene inflows into the populations of Pakistan and northern India.

Genetic Signature of Human Migrations in Pakistan: The above description is a general reading of human movement in and out of Pakistan and, as such, they are only rough approximations. For a deeper understanding of population movements in the past we need to turn to the analysis of genetic data which is slowly accumulating. Such data have proven quite instructive in India for the elucidation of the pattern of human dispersal, but the genetic signature in the current populations of Pakistan is rather muddled and largely illegible. This is because of two reasons. First, the genetic studies in Pakistan have been only few and unsystematic. Second, the original genetic writings have been overwritten several times by relatively recent inflow of genes from the East as well as from the West.

The initial dispersal of modern humans in Pakistan is, of course, believed to be from Africa, small bands of humans dispersing all along the Arabian Sea coast and then northward along the Indus River and its western tributaries up to the Pothwar region. The lineage M and N and their various subclades seem to represent this dispersal. Beyond this, we are blank. Do the remnants of these genetic codes represent the signature of the initial human dispersal or do they represent the overwriting of more recent genetic flows from the East? Since these lineages are particularly concentrated on the southeastern region of Sindh and northeastern area of Punjab (the two corridors of possible communication between ancient Pakistan and the rest of the subcontinent), the latter possibility seems more plausible.



Reconstruction of OIS 5 environment along the Indian Ocean rim and the hypothetical dispersal routes through the Indus Valley and then onwards to the

India-specific haplogroups. There is cline in this distribution: the father one moves toward the East, the more this proportion increases, starting from 30% on the eastern banks of the Indus to almost 50% at the western banks of the Ravi.

The southwestern and Central Asian corridor has played a pivotal role in the history of humankind, witnessing numerous waves of migration of different peoples at different times. This area is of particular importance in addressing the question of the peopling of Pakistan since the people of Pakistan show a strong, although patchy, genetic affinity with the populations around the region known as the Pamir Knot as well as with the area included in

Ganga-Jamuna plains (199)

the present day Iran, Afghanistan and the vast region west of them. Quintana-Murci et al (149) have evaluated the effects of these population movements on the current genetic landscape of the Iranian plateau, the Indus Valley, and Central Asia, by analyzing 910 mitochondrial DNAs (mtDNAs) from 23 populations of the region. This study has allowed a refinement of the phylogenetic relationships of some lineages and the identification of new haplogroups in the southwestern and Central Asian mtDNA tree and is to be discussed in some detail in the next section. The data shows strong genetic diffusion or actual human dispersal from the west to the Indus Valley. All these genetic signatures are, however, of more recent origins and have little light to shed on the initial colonization of Pakistan.

Indus plains exhibit substantial proportions of lineages that can be allocated to three different genetic

components of western Eurasian, south Asian, and, marginally, East Asian origin. In addition to the overall composite picture of lineage clusters of different origin, the researchers observed a number of deep-rooting Pakistan-specific lineages, whose relative clustering and coalescent ages suggest an autochthonous origin in this region during the Pleistocene. The picture is, however, highly complex as it includes substantial genetic contribution from as far as Mongolia (the Hazaras, for example) on one hand and East Africa on the other (The Makranis, for example), sexually asymmetrical mating patterns, founder effects, and femalespecific traces of human migrations. Again, the recent events seem to be overpowering and corrupting the deep rooting genetic signature.

Both geographical distribution of lineages and spatial analysis of molecular variance showed that the Pakistani populations located west of the Indus Valley mainly harbor mtDNAs of westEurasian origin, whereas those inhabiting to the east of the Indus exhibit a sizable portion of the

It must be remembered that not all human migrations were directed to Pakistan; some movements of population also occurred out of Pakistan into India, Afghanistan, and Iran. The migrations into India were primarily through the northern corridor, i.e. along the foothills of the Siwalik, or through coastal hops into Kutch and Gujarat; those into Iran were mainly through the coastal regions and across the southern desert land. These westward movements were, however, on a very small scale and probably sporadic.



Dispersal Waves instead of Dispersal Routes: On a broader scale and on a bigger span of time, the whole process of human dispersal can be visualized as a strong diffusional

wave emanating from one point in East Africa, interacting with other ripples along the way and generating genetic contours that we see today. This situation can be read somewhat more clearly if we choose to subscribe to Eswaran's Demic Diffusion hypothesis, outlined earlier. In this case, we need not identify the 'routes' of human migration but simply have to be concerned about the general direction of the propagation of diffusional wave, which itself was the result of small, random movements of local populations at the wavefront. Replacing the migration route with the overall direction of the wavefront of demic diffusion and eliminating altogether the painstakingly constructed genetic trees, we may arrive at the situation where the contours of the main diffusional wave gets severely distorted when it meets an endless series of deserts and badlands at Iran-Pakistan borders

(Siestan and Baluchistan) and a series of insurmountable mountain ranges around the Pamir Knot and the high Himalayas. While we take cognizance of these major disturbances in the propagation of diffusional wave, we also take note of its practically undisturbed progress along the coastline towards India and beyond. It is these ebbs and flows in demic diffusion that probably determined the first colonization of this region and it is in these contours of the wavefront where we should seek the demarcation of genetic boundaries within the existing populations of the country and the region.

What Happened to the "Locals"? What happened to archaic Homo *sapiens* who already existed and thrived in Pakistan before the arrival of modern humans, is a topic of much controversy. According to one set of opinions, they got completely replaced by modern humans without much interbreeding. According to another set of opinions, the newcomers, the Homo *sapiens*, interbred with the archaics and developed into several distinguishable types of human populations in different parts of the country. These population groups further intermixed within themselves as well as with the migrating populations of the neighboring lands, thereby homogenizing the gene pool on one hand and developing more diverse, but closely related, types of population groups, on the other hand.

The lack of genetic diversity in living humans (including South Asians) has been taken as an evidence for the replacement theory, namely, that modern humans replaced, rather than interbred with the archaic populations that already resided outside of Africa. This brings us back to the debate on human origins and the paths of evolution. Enough has already been said on this in the previous pages and further discussion will not serve any useful purpose.

Currently, the lack of hominin fossils in Pakistan or in the neighboring areas makes it difficult to determine exactly what these pre-existing populations were *neanderthalensis*, or a yet undescribed species of *archaic* Homo. From extensive archaeological deposits in Pakistan and the neighboring countries, it appears that whosoever these hominins were, they enjoyed a lengthy history, with their own trends towards more diverse and sophisticated lithic assemblages (64). However, the fact that these populations went extinct with the influx of modern humans suggests that *Homo sapiens* either had some competitive advantage over pre-existing South Asian hominins, perhaps in terms of increased rates of population growth, more flexible subsistence strategies, or more extensive social networks. Or, should we believe in some form of Multiregional theory, the newcomers interbred with the locals and assimilated them into their common gene pool, giving the allusion as though the locals simply went extinct.

The absence of a distinctive lithic assemblage in Pakistan as well as India, that can be linked to the arrival of newcomers, the dispersal of modern *Homo sapiens* pose new questions. Were there in fact the newcomers to start with who came to this land (and others) and somehow completely replaced the preexisting inhabitants? This is to question the very basis of the conventional wisdom on which the whole edifice of the evolution of modern humans is erected. Or, there is any other explanation? Are we amiss in our search for a 'modern human behavioral package' all over the globe? Alternatively, should not we cease to look at the evolutionary history of humans from the point of view of Europe alone?

Research in behavioral modernity in Africa (180) has shown that early modern human behavior followed multiple development trajectories, rather than a single progression. The question arises : why do we insist on parallels to the European Upper Paleolithic (e.g., blades, carved bone points, beads, etc.) in South Asia and why we try to enforce a particular model of human behavioral

evolution that was crafted to address the specific situation in Europe and the Levant? And, why behaviorally modern humans have to colonize Europe first and then other parts of the Old World and not in the reverse direction? Why modern humans in South Asia should be recognized through the same set of tools as those utilized by the Europeans?

These theoretical questions apart, the only certainty is that Pakistan was populated by humans, modern or not, long time ago, as indicated by an unbroken lithic record across the country. A further conclusion to be drawn is that the composition of human population in Pakistan as well as in other parts of the world has been changing since humans evolved under different pressures of environment as well as under a purely random mutation in genetic material. Natural selection played its role, so did the forces of genetic isolation and gene flows. Some of these changes had a profound effect on the physical characteristics of peoples but some did not. The end result of these dynamic processes is an exquisite array of people of different shape and color throughout the country and in the region around it. Superimposed on these physical differences are the cultural and linguistic differences. These processes have given rise to varied ethnic groups which reside in different geographical areas of the country but sometimes live together in a mutually shared geographical area without mixing together. In this situation, the questions of why, when, and how simply disappear or at least loose their primary appeal.

Conclusion: Modern humans did not evolve in Pakistan in isolation, their journey was most likely in unison with population groups that inhabited the neighboring regions, in the East as well as in the West. Early humans in this part of the world were also an integral part of greater humanity that populated the globe. We are thus forced to look at human evolution and cultural change in Pakistan in context with a much larger picture. Given the remoteness of time, an immensely long cultural period involved, the vast spans of geographic distances, a high level of environmental diversity, and the vast scope of the subject matter, it will be pretentious to even attempt an overview of the course of this journey. Nevertheless, we can review the archaeological record of this region if we keep our attention focused on a very few aspects of cultural change and try to look at human evolution from outside in. Approaches may differ from author to author and the focus may vary.

The received wisdom tells us that early humans evolved in East Africa and from there they spread all over the globe and quickly reach Australia. As the mid-way point between Africa and Australia, and as a large region that supported a savannah environment similar to that of Sub-Saharan Africa, this region was a prime candidate for colonization by early hominids. Although no fossil evidence is yet available, the archaeological evidence (lithic artifacts) from Pothwar in Pakistan indicates that South Asia was colonized by early hominids around two million years ago. The mode of dispersion from Africa to South Asia is believed akin to the one utilized by these creatures in Africa itself, i.e. an apelike territorial expansion through a contiguous grassland that spanned from east Africa all the way to central India on one hand and to central Asia and western China on the other.

The received wisdom also tells us that the ‘modern humans’, i.e. Homo *sapiens*, also evolved in East Africa and that they came to the subcontinent from the West, ostensibly from a Eurasian population that had its roots in the Levant (157,158), and this premise is still implicit in maps of modern human expansions and colonization of continents. Some genetic studies support this scenario and more specific studies highlight the importance of the Indus Delta and South Asia generally in the global expansion of particular genealogical lineages 50,000–70,000 years ago (23,91,103).

Other studies, however, conclude that modern humans dispersed in South Asia through their exodus from East Africa via Bab-el-Mandeb and spreading eastward along the coastal rim of the Indian Ocean. This hypothesis is equally popular among archaeologists and geneticists and is getting increasing support from archaeological record from Arabia, especially that from UAE, redating of fossils from the Far East, and the recent fossil discoveries in South China. Contrary to the chronology previously deduced from the Northern exodus Route, which puts the modern humans in Asia as late as 50,000 years ago and as early as 70,000 years ago, these recent discoveries are pushing the presence of modern humans in Asia to dates that extend beyond 100,000 years ago, implying that modern humans must have left Africa prior to this date (25,52,101).

It was long believed that the modern humans exited Africa with the Upper Paleolithic technology (blades and burins) but recent analyses suggest that dispersal of modern humans may have taken place during the glacial conditions of oxygen isotope Stage 4 (OIS 4) and the interstadial Stage 3 (25,52,76,101). This time period generally corresponds with the Middle Paleolithic of Europe or the Middle Stone Age of Africa. Naturally, all this bears upon the discussion on the initial colonization of South Asia by modern humans. This conclusion is given strength by recent genetic studies in the pattern of non-African mitochondrial DNA (mtDNA) diversity, showing that populations in the region today carry lineages that are part of one of the two first clades to derive from African diversity (namely M* lineages). More recent genetic analyses indicate that certain geographically isolated populations in Southeast Asia retain unique mtDNA lineages with time-depths of 44,000–63,000 years, suggesting that lineage divergence occurred very early in the region. When and how the modern humans reached this region is not clear but a general picture that emerges corresponds to a coastal dispersal skirting the Indian Ocean.

While the arrival of modern humans in Europe is announced by a sudden and rapid technological change, no such cultural transformation is seen in South Asia during the time period when modern humans are supposed to be emerging from Africa and dispersing in Eurasia, completely replacing the archaics everywhere. The technological change is there but it is diffused in its temporal horizon. The nature of change is also different. In spite of this lack of evidence for the arrival of the modern man, the mainstream archaeologists and paleoanthropologists still insist to follow the Out-of-Africa theory to explain the first colonization of South Asia by modern humans. Such a scenario fits very well in the generalized scheme of human evolution and dispersal in Europe but the applicability of such a model is rather questionable over the globe. Some version of the Multiregional evolution and dispersal of modern humans would probably explain the situation better.

III.4. References

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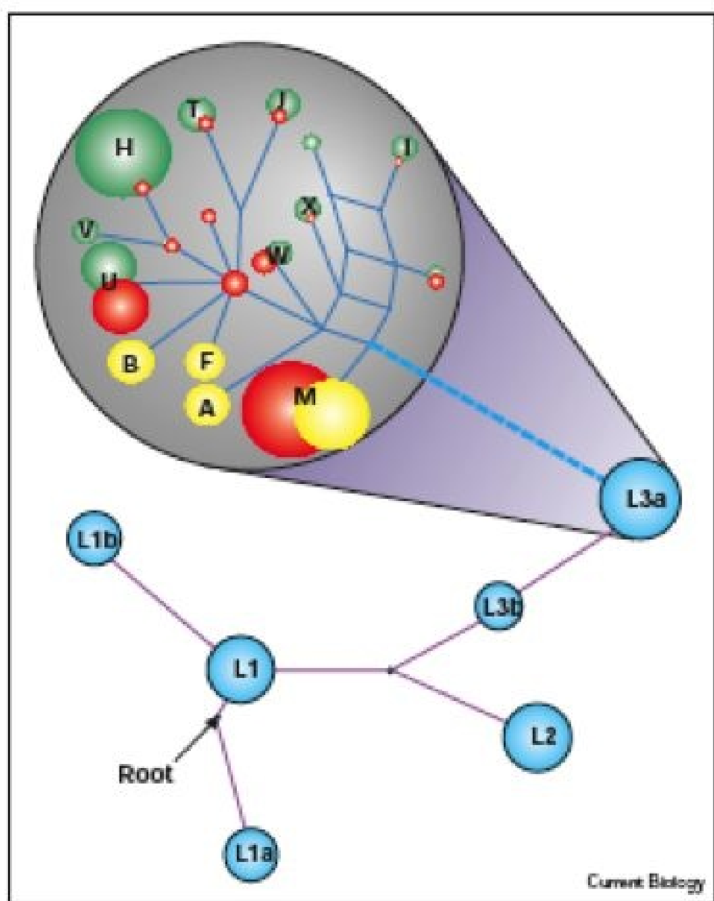
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IV.1. Genetics in the Service of Human History IV.2. Genetic Legacy of the West

IV.0. Genetic Footprints of the Indus Man and the Legacy of the Borderlands



This section deals with certain aspects of genetic composition of the present-day Pakistan's populations and its relationship with the neighboring populations in India, Iran, Cental Asia, and ultimately to the Near East and Africa. Understanding the genetic composition of the current population is important both for questions concerning the early settlement of this piece of land and the demographic changes wrought by relatively more recent migrations and invasions, which have been the fate of this region since the millennia past. These interactions with population groups in the neighboring areas have enormously enriched the cultural history of Pakistan and made its population genetically one of the most diverse in the world.

Invaders, including the so-called Aryans, Macedonians, Arabs, Mongols, Turks, etc. have all contributed to this ethnic diversity and it is in itself an interesting area of research. This is, however, not of our primary interest in this Section: we are primarily concerned here with the deep rooted, the connections of the present-day populations with the Stone Age hunters and gatherers in this region. Evidently, the Greater Indus Valley, that is, the present-day Pakistan, was not settled in isolation; as discussed in the last Section, the initial colonization of this land was an integral part of the grand colonization process that was operative all over Eurasia. We must understand the working of this process in context with the whole of Eurasia but more particularly with the neighboring lands. In this context, the borderland areas, particularly Afghanistan, Iran, and Central Asia in the West and India in the East, are of special interest to us. Although a systematic investigation has not yet begun in earnest and a co

It (the genetic signature) is, in fact, like a palimpsest, on which the writings
have been imprinted in layers, getting
fainter and fainter as we reach the bottommost layers. The job of population geneticists is to decipher these writings, determine their chronological sequence, and differentiate the most recent signature from the oldest scribbles.

herent picture in these respective areas is only slowing emerging, enough data have already accumulated to warrant a review of the available information with the hope that we may spot a link or two between the genetic make-up of the peoples in these areas and their interrelationship. It is for this reason that we devote a separate and somewhat lengthy chapter to the research in this field.

In present-day Pakistan, the Baluchis, Brohis, Makranis, Muhajirs, Hazaras, and Sindhis constitute the major southern populations of Pakistan. The major northern ethnic groups include the Balti, Burushos, Kafirs, Kashmiris, Pashtuns, and Punjabis. Some of these groups have been studied quite extensively but others have been more or less ignored for the complexity of their culture or the extreme entanglement of their genetic links. We shall review this background to the extent it is known. True to the time period covered in this volume, our interest is, evidently, more in exploring the Stone

Age linkages than discussing the more recent genetic events. But the genetic signature has been written and overwritten a number of times on these populations. It is, in fact, like a palimpsest, on which

the writings have been imprinted in layers, getting fainter and fainter as we reach the bottommost layers. The job of population geneticists is to decipher these writings, determine their chronological sequence, and differentiate the most recent signature from the oldest scribbles.

We particularly attempt to follow the genetic footprints of modern humans as they colonize the Indus Valley and occupy the highlands and plateaus that surround

the Indus plains. As we proceed, we try to connect their genetic footprints with those which are seen in the borderlands and attempt to figure out the movements of these diverse population groups in and out of this land. The analysis of genetic material of current populations does not provide us with any information about the routes of human migrations but it does give us some approximate timelines when such migrations could have taken place. In this respect, genetic data, obtained both through mtDNA and Y-chromosome DNA analysis, is of immeasurable utility.

Archaeological evidence in Pakistan does not advocate the settlement of the region by ‘modern’ humans at any specific point in time; the lithic record seems to indicate an unbroken technological continuity, punctuated here and there by some long and some short periods of population migrations or extinctions and recolonization. The same situation seems to be prevailing in the neighborhood. In spite of this absence of any clear evidence for the ‘arrival’ of modern man anywhere in South Asia or Central Asia, we are somehow conditioned to seek the first settlement of this area by the ‘modern man’ with a defined point in time, corresponding with the ‘Upper Paleolithic Revolution’ in Europe. In Europe, this event is supposed to have taken place around 40,000 years ago; in Pakistan, and in India as well, such an occurrence is not clearly visible. Even if we spot it through one criterion or the other, it seems to stretch farther in the past. This is more so when we are dealing with genetic evidence. In this context, we consider the genetic roots as ‘deep‘ if they go back to beyond 50,000-70,000 years ago.

Contrary to these, there are some other lineages, such as those of the Hazaras, the Parsees, the Muhajirs, and the Makranis, whose genetic signatures in Pakistan are of relatively recent origins. There are still others, whose traces we find in the current populations of Pakistan but do not know their time of origins. The task of reading this signature has just begun but we have already started to reap the benefits of these efforts.

Population genetics is an involved subject and archeogentics is even more. Students of history and archaeology are generally not familiar with the basic concepts or even the terminology geneticists use to report their findings and to discuss their results. In view of this impediment, we begin this section with a hefty chapter on the role of genetics in elucidating population history. Some of the basic concepts have been reviewed and the relevant terminology explained. Further readings may be required and the Bibliography at the end of this volume could serve as a guide.

IV.1. Genetics in the Service of Population History



During the last two decades, the question of human evolution, the emergence and dispersal of modern humans, the Homo *sapiens*, has been addressed more and more using genetic data. The basis behind this research is that genetic variation in the world

populations today is a reflection of the past. Thus, combined with inferences from fossil and archaeological records, genetic data may supply answers to some basic questions about human population history. This methodology is referred to as *archaeogenetics*, a term so elegantly coined by Colin Renfrew. It refers to the application of the techniques of *molecular population genetics* to the study of the human past. This can involve:

■ the analysis of DNA from modern populations

(including humans and domestic plant and animal species) in order to study human past and the genetic legacy of human interaction with the biosphere;

■ the analysis of DNA recovered from archaeological remains, i.e. ancient DNA; and

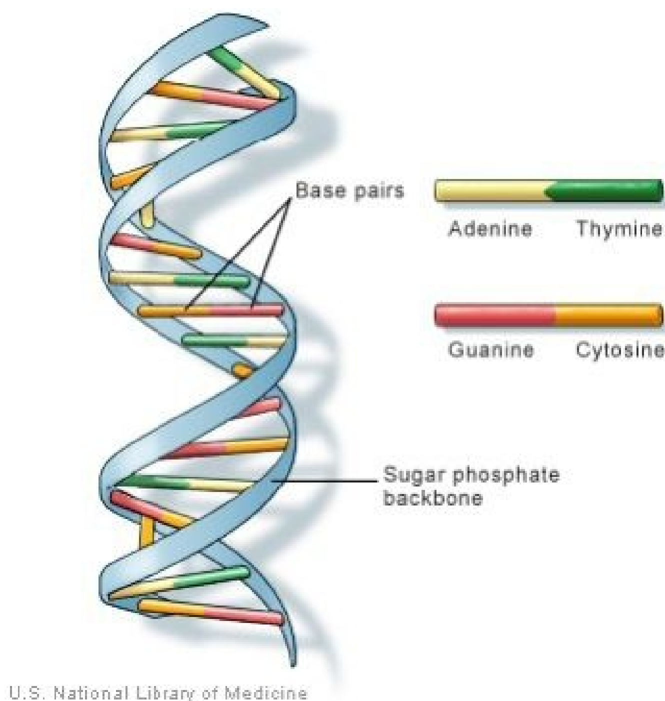
■ the application of statistical methods developed by molecular geneticists to study and analyze the collected data.

The discipline has its origins in the study of human blood groups and the realization that this classical genetic marker provides information about the relationships between linguistic and ethnic groupings. Luigi Luca Cavalli-Sforza used these classical genetic markers to examine the prehistoric population of Europe, culminating in the publication of *The History and Geography of Human Genes* in 1994. Since then, the classical genetic markers have been replaced by more sophisticated DNA analysis. As a result of these efforts, the genetic history of most of the human population groups has been mapped, at least in its outlines.

The application of genetics in understanding of evolutionary history of mankind covers at the most the last 100,000 years. This is only a part of what concerns us here. Nevertheless, archaeogenetics has shone a bright light onto a field previously dominated by collections of stone tools and a few poorly dated skeletal remains, restricted to a brief period of time in human history. Archeogentics is indeed a new tool of investigation at our disposal.

Several authors have described this progress in enticing details but still comprehensible for the common reader. One such narration is that of Stephen Oppenheimer‘s *The Real Eve*, another is Spencer Well‘s *The Journey of Man*, and still another is Steve Olson‘s *Mapping Human History*. Of

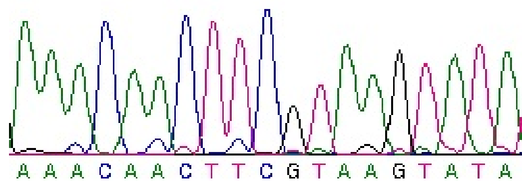
course, there are several other books and review articles, equally illuminating and equally stimulating; some of them are listed in the Bibliography at the end of this book. Some of the recent college textbooks also outline the basics of population genetics and its methodology.
Before turning to details of genetic tracking of human history in Pakistan and the surrounding region, it should help us to look at some of the ideas behind genetic inheritance and familiarize ourselves with the terminology of population genetics in general and archaeogenetics in particular. The concepts are simple, being related to our own everyday understanding of and preoccupation with inheritance, but are often misrepresented, either for reasons of hype or because they are veiled in jargon. Population genetics, more accurately for our purpose, the field of *archaeogenetics*, is a relatively new discipline and, hence, the pace of discoveries is rapid. There are also plenty of controversies. All this makes the in-depth coverage of accumulated data somewhat difficult. Nevertheless, the following brief background should suffice for pursuing of subsequent discussions in this book.
Population Genetics: *Genetics* is the study of genes, and tries to explain what they are and how they work. Genetics tries to identify which features are inherited, and explain how these features are passed from generation to generation. At the level of the individual, the study of genetics suggests the way the traits are transmitted from one generation to the next and enables a prediction about the chances that any given individual will display some phenotypic characteristic. At the level of the group, the study of genetics takes on additional significance, revealing mechanisms that support evolutionary interpretations of the diversity of life. Population genetics is the study of the frequency distribution of various genetic markers and their change under the influence of the four evolutionary forces: natural selection, genetic drift, mutation, and gene flow. It also takes account of population subdivision and population structure in space. The study of population genetics is to read the sequences of nucleotides, the genetic building blocks of a genome, and correlate them within each group of population as well as compare them with others. This is essentially a statistical exercise.
From the early work of population geneticists who sought to discern patterns of historical population movements from the blood groups, serum proteins, and enzymes of a few hundred donors, we have progressed to mega-base sequence comparisons from tens of thousands of individuals with increasingly fine spatial as well as temporal resolution. Highly informative loci, enzymatically amplified from saliva or hair samples collected under field conditions, have freed us from a reliance on population inferences based on acculturated or urbanized groups. What characterizes these studies is a shift from the discovery of individual molecular characters themselves to a focus on the populations carrying them. Because of automated technologies and linkage analysis, we are poised to harvest a wealth of information about our past, if we are successful in moving beyond a current polarization regarding models of human evolution.
Genotype and Phenotype: In genetics, a feature of a living thing is called a “traits”. Some traits are part of an organism's physical appearance; such as a person's eye-color, height or weight. Other sorts of traits are not easily seen and include blood types or resistance to diseases. Some traits are inherited through our genes; such traits which result due to inheritance alone are called *genotypes*. Other traits come from interactions between our genes and the environment; these are called as *phenotypes*.
DNA: DNA (Deoxyribonucleic acid) is a long chain molecule that contains the genetic instructions used in the development and functioning of all known living organisms, including humans. It is double-stranded molecule consisting of two chains running in opposite directions. The chemical nature of the bases in double-stranded DNA creates



Schematics of a DNA molecule

a slight twisting force that gives DNA its characteristic gently coiled structure, known as the double helix. The two strands are connected to each other by chemical pairing of each base on one strand to a specific partner on the other strand (see the figure, above).

Genes: DNA is made of a sequence of simple units, called *genes*, the order of these units spell out instructions in the genetic code. This is similar to the orders of letters spelling out words. The organism "reads" the sequence of these units and decodes the instruction. A gene directs the development of a single observable or identifiable trait.



The result of a DNA analysis is often displayed in the form a graph like this

When we speak of the gene for blue eyes, we are referring to the portion of a DNA molecule that contains the genetic code for the proteins that give eyes their characteristic color. A gene, then, is not really a separate structure but a location, like a dot on a map. It is estimated that human DNA contains at least 50,000 different genes.

Allele: Genes are inherited as units, with two parents dividing out copies of their genes to their offspring. One can think of this process like mixing two hands of cards, shuffling them, and then dealing them out again. Humans have two copies of each of their genes and when people reproduce they make copies of their genes and put them into eggs or sperm, but only put in one copy of each type of gene. When an egg joins with a sperm, this gives a child a complete set of genes. This child will have the same number of genes as its parents, but for any gene one of their two copies will come from their father, and one from their mother.

The effects of this mixing depends on the types (the *alleles*) of the gene one is interested in. If the father has two copies for an allele for red hair, and the mother has two copies for brown hair, all their children will get the two alleles that give different instructions, one for red hair and one for brown. The hair color of these children would depend on how these alleles worked together. If one allele overrides the instructions from another, it is called the dominant allele, and the allele that is overridden is called the recessive allele. In the case of a daughter with alleles for both red and brown hair, brown is dominant and she ends up with brown hair.

A population of organisms evolves when an inherited trait becomes more common or less common over time. In terms of genetics, this is called a change in allele frequency - such as an increase in the frequency of the allele for blond hair. Alleles become more or less common either just by chance (in a process called genetic drift), or through natural selection. In natural selection, if an allele makes it more likely that an organism will survive and reproduce, then over time this allele will become more common. But if an allele is harmful, natural selection will make it less common. Mutations create new alleles. These alleles have new DNA sequences and can produce proteins with new properties. The combination of mutations creating new alleles at random, and natural selection picking out those which are useful, causes adaptation. This is when organisms change in ways that help them to survive and reproduce.

Chromosomes: DNA molecules do not float freely about in our bodies; they are located on structures called *chromosomes* found in the nucleus of each cell. Chromosomes are nothing more than long strands of DNA, covered with some kind of protective protein coating. The chromosomes of most cells can easily be seen under a conventional light microscope. Each kind of organism has a characteristic number of chromosomes, which are usually found in pairs. For example, humans have 23 pairs of chromosomes. The two chromosomes in each pair contain genes for the same traits, but there may be variants of these genes, one might be for brown eyes and the other for blue eyes. As explained earliere, genes that are located on paired chromosomes and are coded for different versions of the same trait are call *alleles*.

mtDNA: In human cells, most genes are confined to the nucleus, limited to two copies per cell and transmitted, as described above, equally from both parents according to Mendel‘s laws. A major exception is represented by the mitochondrial DNA (mtDNA) genes. They are located within the mitochondria, the outer region of the cell, organized in a small circular molecule of DNA, which is transmitted as a *non-recombining* unit only through the mother. The sequence of mtDNA is, however, not immune to change. It does change over time through exterior factors, the major of them is random *mutations*. These mutations accumulate over time and can be detected as past events in the mtDNA of the current human population groups. The time frame of these mutations is such that human mtDNA contains a molecular record not only of the genealogical history but also of the migrations of women who transmitted it through the generations. A comparison of mtDNA sequence in a population can reveal a molecular *phylogeny* (i. e., the history of organismal lineages as they change through time).

mtDNA also mutates at a higher rate compared to nuclear DNA, so it gives researchers a more useful, magnified view of the diversity present in a population. Because the process of molecular differentiation is relatively fast and occurred mainly during and after the recent process of dispersal into different parts of the world, subsets of mtDNA variation usually tend to be restricted to particular geographic areas and populations. Recent analyses of this variation at the highest possible level of

molecular resolution (i.e. that of complete mtDNA sequences) are now enabling us to determine where and when particular branching events are likely to have occurred, as the first step in the reconstruction of prehistoric human dispersals.

DNA analysis, in particular maternally inherited mitochondrial DNA (mtDNA), is now routinely used to trace ancient human migration routes and to obtain absolute dates for genetic prehistory. The errors on absolute genetic dates are often large and depend partly on the inherent evolutionary signal in the DNA data, and partly on our imperfect knowledge of the DNA mutation rate. Despite their imprecision, the genetic dates do provide an independent, consistent and global chronology linking living humans with their ancestors. Combining this chorenology with archaeological and climatological data, a fairly accurate picture of human migration and dispersal can be drawn (1).

Y-Chromosome DNA: There is one piece of nuclear DNA that has recently proven to be an invaluable tool for inferring details about human history – providing us with far greater resolution than we ever thought possible about the paths followed by our ancestors during their wandering. It is the male equivalent of mtDNA, in that it is only passed from father to son. For this reason, it defines a uniquely male lineage – a counterpart to the female line illuminated by studying mtDNA. It is known as *Y-chromosome*. Part of the reason for the Y chromosome providing population geneticists with the most useful tool available for studying human diversity is that, unlike mtDNA, which is roughly 16,000 nucleotide units long, the Y is huge – around 50 million nucleotides. It therefore has many, many sites at which mutations may have occurred in the past. Evidently, more polymorphic sites give us better resolution. It also lengthens the time span for which we can detect the accumulated mutations in a population group.

DNA Sequencing: The information in DNA is stored as a code made up of four chemical bases. The order, or *sequence*, of these bases determines the information available for building and maintaining an organism, similar to the way in which letters of the alphabet appear in a certain order to form words and sentences. A comparison of DNA sequences from mtDNA in a population reveals a molecular *phylogeny*. Almost all our DNA - 99.9 percent of the three billion ‘letters’ or nucleotides that make up the human genome - is the same from person to person. But interwoven in that last 0.1 percent are telltale differences. A comparison among, say, East Africans and Native Americans can yield vital clues to human ancestry and to the inexorable progression of colonization from continent to continent.

For analytical purposes, one can compare DNA sequences and count the number of differences between samples. With the recent explosion of genetic technology and the development of the Human Genome Project, geneticists now have access to the complete DNA sequence of human beings (although we are far from understanding what much of the DNA actually does). Although such advances are often thought of as having primary importance for biomedical applications, they are also a valuable resource for studying human population history.

Genetic Markers: The various blood types, blood proteins, and blood enzymes (collectively referred to as *classic genetic markers)* have been very useful in the study of human population history. These genetic markers have a number of advantages over physical traits such as height or cranial shape. In addition to having a known mode of inheritance, genetic markers are constant throughout one's life. Blood type does not change with age, diet, or exercise as many physical traits do. Genetic markers allow a closer look at the underlying genetic code than physical measurements.

Analyzing mitochondrial and Y chromosome DNA from human populations has turned up hundreds of genetic markers in recent years. In modern genetic work, a genetic marker is a known DNA sequence. It can be described as a variation, which may arise due to mutation or alteration in the genomic loci, that can be observed. A genetic marker may be a short DNA sequence, such as a sequence surrounding a single base-pair change (single nucleotide polymorphism, *SNP*), or a long one, like *minisatellites*. Some commonly used types of genetic markers are RFLP (or Restriction fragment length polymorphism), AFLP (or Amplified fragment length polymorphism), RAPD (or Random amplification of polymorphic DNA), VNTR (or Variable number tandem repeat), Microsatellite polymorphism, SNP (or Single nucleotide polymorphism), STR (or Short tandem repeat), SFP (or Single feature polymorphism. Microsattelite map and SNPs are most commonly used as these are easy to use with automated laboratory equipment.

Factors for Genetic Change: Notwithstanding the expected stability of genetic composition of a population, there are several forces that induce changes and create diversity over time as well as over geographical areas. We shall review here a few.

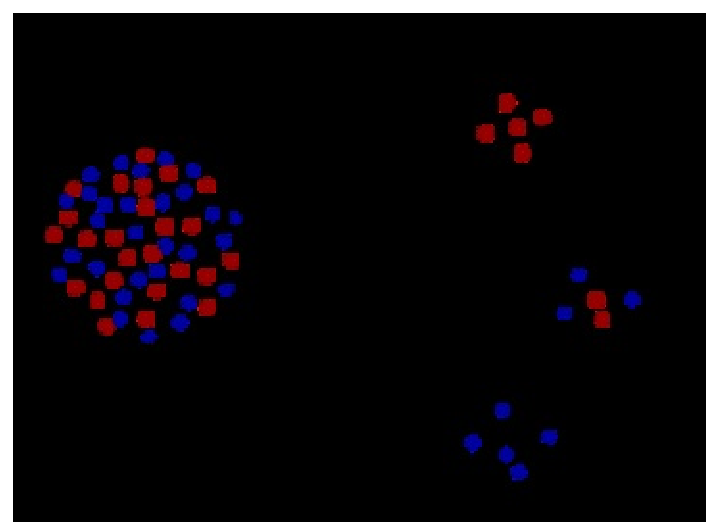
Mutation: The ultimate source of change is mutation of genes. Although mutation is normally a rare occurrence, the large number of genes in each individual sex cell, the large number of sex cells produced, and the large number of individuals in a population mean that there will always be new mutant genes. Geneticists have calculated rates at which mutation can be expected to occur over time. Dividing the total number of genetic differences between two populations by an expected rate of mutation provides an estimate of the time when the two shared a common ancestor. Many estimates of evolutionary ancestry rely on studies of the mtDNA. The mtDNA accumulates mutations about ten times faster than nuclear DNA. As a result, mtDNA is altered so quickly that it is easy to measure the difference between one human population and another, since separate groups have accumulated different sets of mutations. Two closely related populations should have only minor differences in their mtDNA. Conversely, two very distantly related populations should have large differences in their mtDNA.

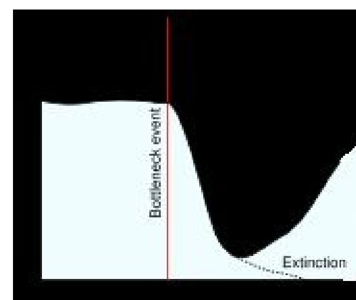
Genetic Drift: Another important evolutionary mechanism of genetic diversity is a random effect called *drift*. Genetic equilibrium is most effectively maintained in populations of a size large enough to allow for a wide choice of mates in random mating patterns, but if a portion of a macropopulation becomes isolated and is prevented from backcrossing with members of its parental population or with members of other gene pools of its own species, it will form its own "private" gene pool with gene frequencies that distinguish it from other populations. Writing in the 1930s, the American geneticist Sewall Wright (1889-1988) observed that the drift effect is an evolutionary mechanism, for if reproductive isolation continues over a period of time, a population may evolve reproductive isolating mechanisms that separate it completely from the larger population from which it was originally derived.

Genetic drift is a statistical phenomenon. A basic rule of probability is that chance events are more likely when the number of events is small and less likely when the number of events is large. To understand this, let's take the example of coin flipping, which is often used in the teaching of the basic concept of probability in our schools and colleges. If you flip four coins and get all heads, it is not that unlikely an event - we expect to see that out of 16 times. However, if you flip ten coins, the chance of getting all heads is much, much smaller; this will happen only once in 1,024 times. If you flip thirty coins, the probability of getting all heads is virtually zero. The same principle applies to genetic drift.

Smaller populations are expected to drift more than larger populations. Because of genetic drift, smaller populations will experience more fixation and extinction of alleles and thus will have less genetic diversity than larger populations. Perhaps the regional differences in genetic diversity we see in the world today are simply a reflection of ancient differences in population size.

Gene Flow: Still another way a population can increase its degree of genetic variability is to receive genes from an already existing gene pool of the same species, a process called *gene flow*. It may be a reciprocal process between populations, one way, or very inhibited due to geographical and, in the case of human beings, social barriers to exogamy. A clear example of geographic barrier to gene flow is the Indus River, the west of which we find population groups with predominantly western genetic material while the populations on the eastern side are poor in these genes. Another example is between India and Pakistan as a whole. Whereas we observe a strong influence of Indian-specific genes (the M lineage) in the Sindhi population, such an influence is radically diminished as we move north-ward along the borderline up to Kashmir. The former effect is due to an easy access between Sind and Indian Gujarat while the latter effect is due to the presence of the vast desert, the Thar, between the two sets of population groups. Gene flow occurs when previously separated groups are able to interbreed, as, for example, when a river that once separated two populations of small mammals changes course. Migration of bands of individuals may also lead to gene flow. Such examples in the ancient history of Pakistani population are numerous, as will be seen in the next few chapters.


Founders Effect



Population Bottleneck

Natural Selection: The factors for change listed above may produce gradual change in a population, but that change would not necessarily make the population better adapted to its biological and social environment. Genetic drift, for example, often produces strange characteristics that have no survival value; mutant genes may be either helpful or harmful to survival. It is the action of *natural selection* that makes evolutionary change adaptive.

Natural selection refers to the evolutionary process through which factors in the environment exert

pressure that selects some individuals and not others to reproduce the next generation of the group. In other words, instead of a completely random selection of individuals whose traits will be passed on through heredity to the next generation, there is a selection by the forces of nature. In the popular press, natural selection is often equated with the survival of the fittest, in which the weak and the unfit are eliminated from the population by disease, predation, or starvation. Obviously, the survival of the fittest has some bearing on natural selection; one need hardly point out that the dead do not reproduce. But there may be many cases in which individuals survive but do not reproduce. The result is that over a period of generations, the population shows a measure of adaptation to its environment.

Natural selection is the guiding and stabilizing force in evolution, since it works upon the effects brought forth by other evolutionary mechanisms. It is a conservative process that checks the potential for unlimited variation brought about by potential for unlimited variation brought about by gene assortment, gene and gene flow. Natural scribed as nature's arbiter, while adaptation is the mediator between an organism and its environment. While natural selection is of utmost importance in the study of the evolution of man, it is not a factor in the study of population dispersal and peopling of continents.

Isolating Mechanisms*:* Certain factors, known as *isolating mechanisms*, serve to separate breeding populations, creating first divergent races and then divergent species. From the point of view of archeogenetics, two isolating mechanism are the most important: *Founder's Effect* and *Population Bottlenecks*.

Many world populations were founded by small groups of humans moving and leaving their large ancestral groups behind. Individuals in these small groups multiplied over time and contributed to a rise in population. This resulted in what is known as genetic *bottleneck* – a narrowing or restriction of the number of gene variants present in a reduced population. A population bottle-neck can also happen if a drastic reduction in population occurs caused by adverse phenomena such as famine, epidemics, floods, or warfare. As these survivors start reproducing, a population with new genetic composition will arise. The same effect is achieved through the so-called *founder effect*, when a small number of individuals inter-marry with each other and give rise to a large population. These two effects are similar in the sense that they both first involve population reduction.

The phenomena of population bottleneck and Founders' Effect are relevant to the discussion of human dispersal as almost all theories that seek the genetic composition of the present populations in varied region one way or the other postulate one or several bottlenecks and Founders' Effect. They are important in theoretical discussions on the evolution and spread of humans in general. The variarecombination, mutation, selection has been detion in human DNA is minute compared to that of other species. They relate it to the hypothesis that during the Late Pleistocene, the human population was reduced to a small number of breeding pairs — probably no more than 10,000 and possibly as few as 1,000 — resulting in a very small residual gene pool.

Multiple population bottlenecks, some very drastic, have been pointed out by several population geneticist investigating the movement and genetic diversity of different populations. A series of bottlenecks, implying a precarious existence of humans to near extinction, not once but several times in their history, does not appeal to logic. At the same time, however, the results cannot be explained in any other way. To reconcile these difficulties, Eswaran has advocated his theory of demic diffusion wherein only a small number of individuals, at the front of the diffusion wave, is involved in genetic

interaction with the rear end of the preceding wave, thus creating the effect of a perpetual bottle neck effect (2).

Some isolating mechanisms are geographical, preventing gene flow between members of separated populations. Isolating mechanisms may also be social rather than physical. Social isolating mechanisms are thought to have been an important factor in speciation during human evolution. They continue to play a predominant part in the maintenance of so-called racial barriers. Although mating is physically possible between any two mature humans of the opposite sex, the awareness of social and cultural differences often makes the idea distasteful perhaps even unthinkable; this isolation results from the culturally implanted concept of a significant difference between "us" and "them." Yet, as evidenced by the blending of human populations that has taken place in many parts of the world, people are also capable of reasoning away social isolating mechanisms that would, in the case of other animals, lead separate races to evolve into separate species. Social separation has not been a significant part of humanity; the caste system and its effect on population isolation in India are quite recent (probably not older than 3,000 years).

Molecular Clock, Coalescence or Most Recent Ancestor: Study of human diversity through the mapping of genetic changes can lead to the history of population groups or at least to the

A clear example of geographic barrier to gene flow is the Indus River, the west of which we find population groups with predominantly western genetic material while the populations on the eastern side are poor in these genes. Another example is between India and

Pakistan as a whole. Whereas we observe a strong influence of Indian-specific genes (the M lineage) in the Sindhi population, such an influence is radically diminished as we move north-ward along the borderline up to

Kashmir. The former effect is due to an easy access between Sindh and Gujarat while the latter effect is due to the presence of the vast

desert, the Thar, between the two sets of population groups.

time of bifurcation or forking of a mutated population from its stem. These calculations, surely statistical in nature and based on several procedural assumptions, lead to the determination of *coalescence* time of the branch with the stem or *most-recent-ancestor* of the two branches of populations under investigation. Coalescence is a central concept in evolutionary genetics that stands for the reduction of the number of common ancestors of the extant genetic lineages when looking at time in retrospect. While genetic sequences accumulate mutations over time, the coalescence methods attempt to reconstruct the process of divergence by assuming that sequences most similar to each other share a more recent common ancestor than those that are more distant.

Molecular clock is based on the percent difference (number of mutations) in proteins or DNA found in extant species. The clock is calibrated by determining, based on geological and paleontological evidence, at which time i n t h e p a s t v a r i o u s branches diverged. Then, determining the number of mutations found in equivalent DNA segments of living population allow us to run the clock backwards and find out at which point in the past they diverged, even in the absence of fossil remains. *Coalescence age* of any particular lineages often differ from investigator to investigator as they utilize different assumptions in their calculations. The coalescence age calculated through mtDNA is

generally shorter than that calculated through Ychromosome DNA analysis. The molecular clock is based on the assumption that most mutations are selectively neutral and that their accumulation over

generations is entirely due to drift. This assumption is increasingly being questioned.

Genetic Diversity and Population History: Genetic diversity is a measure of the variation at the level of individual genes (polymorphism). It refers to the total number of characteristics in the genetic makeup of different populations of a species. Human genetic diversity is the natural variation in gene frequencies observed between the genomes of individuals or groups of humans. In its elementary level, genetic diversity is represented by differences in the sequences of nucleotides that form the DNA within the cells of the organism; it provides a mechanism for populations to adapt to their ever-changing environment. Variation can be measured at both the individual level (differences between individual people) and at the population level, i.e. differences between populations living in different regions

With the passage of time, populations divide into subpopulations because of various cultural and demographic reasons. The consequent demographic impact, primarily population size, results in increased genetic diversity among sub-populations because of genetic drift. When such subpopulations remain isolated from one another so that individuals of one subpopulation do not exchange mates with other subpopulations, genetic diversification is hastened. (Fusion of populations also occurs, but is possibly much less common than fission). Conversely, admixture or the exchange of genes, increases genetic affinities between subpopulations. The primary barriers to admixture are cultural and linguistic differences and geographical distance. Thus, one expects genes, cultures, and languages to evolve in tandem. This applies especially to genes that are not subjected to the differential pressures of natural selection. It is because of this expected phenomenon that correlating genetic diversities and affinities with cultural and linguistic histories is of potential interest to human biologists.

Cann et al. (3) used the comparisons of DNA sequences to measure the genetic diversity of individuals within a population as well as between the populations. They found the highest amount of mtDNA diversity in East Africans. This finding has been replicated in a number of other studies of mitochondrial DNA, as well as studies of repeated nuclear DNA sequences and studies of physical characteristics, such as cranial measures and skin color. Given the same finding across a wide number of traits, it appears conclusive that the highest levels of genetic diversity tend to be found in subSaharan African populations. Cann and her colleagues interpreted these regional differences in mitochondrial diversity as support for an African replacement model of human origins. They inferred that regional differences in diversity are a reflection of a recent African origin of our species followed by dispersal (and replacement) out of Africa. How can this be? The basic assumption used here is that genetic diversity reflects the age of a population.

One problem with this inference is that it assumes that the African and non-African populations separated and had little subsequent gene flow between them. For other geneticists, this assumption does not hold. We observe gene flow between peoples in different parts of the world today, and there is ample evidence that this occurred over long periods of time in the past. When populations mix genes, levels of diversity are affected; the greater the gene flow, the higher the diversity, because gene flow introduces new "diversity' into a population.

Allele frequencies are used to estimate genetic distances between populations. Regardless of what

specific types of genetic data are used, an objective in many studies of human population history is to come up with a set of allele frequencies that show relationships among a set of populations. The larger the distance, the greater the dissimilarity between populations, whereas the smaller the distance, the greater the similarity. Stated another way, the lower the distance, the more two populations are related genetically, and the higher the genetic distance, the less two populations are related genetically.

Genetic diversity of human populations is a good measure of the history of human race. Granted that these genetic symbols have been repeatedly redrawn and over-written, one can often still decipher their faded tracing to read the history of man. In fact, as John H. Relethford (4) puts it, genetic diversity of living humans is more like a palimpsest than a complete erasure; it reflects a mixture of past events, both recent and distant in time. Throughout written history and prehistory, human populations have moved into new territories, mated with neighbors close and far, changed in size, and undergone changes that affected genetic diversity. What we see in the world today is the combined outcomes of all such events, large and small, global and local, across the span of time. We see a composite image, one that can be analyzed by peeling away the layers of the palimpsest to reveal information on the history of human population. The point here is that the patterns of genetic variation that we see in the world today were not caused by any single event, but instead reflect a palimpsest, a mosaic of events that occurred at different times and in different places. As such, our genetic diversity more closely resembles a partially painted wall, with visible images both old and new, rather than a newly painted wall where all past events have been erased. Our goal, difficult though it often is, is to peel away the different layers to determine *which* events affected current genetic variation, and *how*. Just as historians have methods to peel away the different levels of text in a palimpsest, anthropologists and geneticists have ways of doing the same thing with genetic variation. The shuffling of genes, an evolutionary mechanism for generating diversity, means that the pedigree of human genome is at present too complex to untangle.

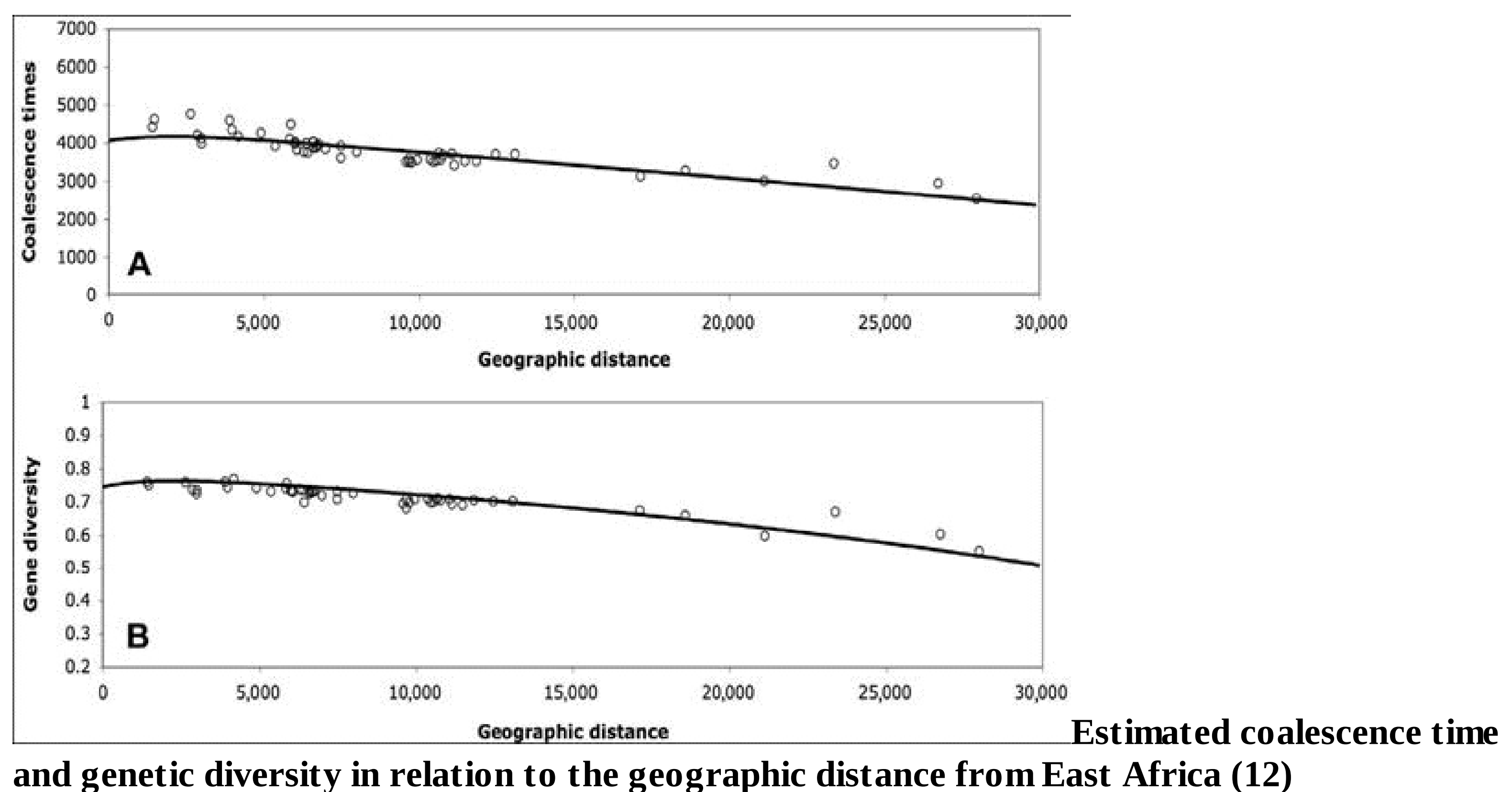
Genetic Diversity and Geographic Distances: It has been variously demonstrated that genetic variation in many areas of the world is predominantly structured by geography, not by language or ethnic affiliation (5,6). For example, the availability of a large data set of DNA samples from 11,000 individuals distributed worldwide and typed at hundreds of genetic markers led Rosenberg (7) and associates to describe extremely strong patterns in the geographic distribution of genetic diversity in humans. That genetic variation in many areas of the world is predominantly structured by geography, not by language or ethnic affiliation was also described by others (5,6). According to these studies, genetic differentiation between populations increases essentially linearly with geographic distance, computed along landmasses (8,9,10). Even more striking is the observation that geographic distance along landmasses from East Africa (a likely origin of anatomically modern humans) is an excellent predictor of the genetic diversity of individual populations throughout the world. Indeed, genetic diversity decreases smoothly with increasing geographic distance from Africa (11,12,13.).

Hua Liu, et al (12) is perhaps the latest voice confirming this geographical model. His model suggests that various environmental factors tend to be relatively homogenous for human migration patterns, when considered over a large geographic distance, thus ignoring the topographical features, including major rivers, high mountains, lakes, marshes, and deserts, in the way of expanding human populations. This is indeed surprising and

The correlation of genetic diversity with geographic distance has far reaching theoretical

implications for the origins and spread of modern humans. Initially, these patterns were offered as a a compelling evidence for the hypothesis of recent African origin of modern humans and complete replacement of pre-existing species (14,15). However, tsuch an evidence quickly went out of circulation. It was realized that the idea that there was a widespread genetic movement out of Africa does not necessarily imply an out-of-Africa population movement. Secondly, the data do not require a replacement of pre-existing non-modern populations.

One popular hypothesis to account for this pattern of diversity has been a "serial founder effect". The idea is that a small group left Africa to found a population in West Asia. Then a small



Estimated coalescence time and genetic diversity in relation to the geographic distance from East Africa (12)

rather counter-intuitive and examples contrary to this sweeping generalization are numerous. One handy example is that of the river Indus which is a clear impediment to the diffusion of the western genes from the area in the West to that in the East, as judged by the genetic make-up of the presentday Pakistani population. Another example is that of the Thar Desert, and still another is the Himalayas between the Indian continent and China.
group from *that* population left to found a population in, say, India. Then a small group from India left to found a new population in Thailand. And so on, until the entire world was populated. Under this hypothesis, a substantial number of African alleles would be left behind in Africa. Even more of these alleles would be left behind in West Asia. More would be left behind in India. In the end, the diversity of populations would reflect the series of founding events that trace their ancestors' movement out of Africa and into the rest of the world. This serial founder effect from Africa across the globe could account for the decline in genetic variation in populations further and further from Africa. Notice that the serial founder effect, assumes no interbreeding between human groups.

A second hypothesis is presented by Templeton (16), who proposed that *several* founder effects happened at different times in the Pleistocene, each carrying one or more genetic variants out of Africa. The pattern of genetic variation told him that *some* genes left Africa during the Lower or Middle Pleistocene, while others dispersed later, during the Late Pleistocene. For Templeton this

pattern indicates multiple dispersals, none of which was sufficient to wipe out the genetic contribution of earlier dispersals. This scenario would lead to a pattern of correlation of genetic and geographic distance (because most genes *have been* affected by isolationby-distance for a long time), while the recurrent dispersals would explain the decline in genetic variation outside of Africa.

A third hypothesis is that population size was simply greater within Africa than within Eurasia. The smaller population size (along with isolation-bydistance) would explain the difference in genetic variation. We may consider a fourth hypothesis also: that natural selection could have tended to create slightly more genetic uniformity within Eurasia and slightly more genetic diversification in Africa. Such a scenario could be justified on ecological grounds: African populations cover a wider range of ecologies and have historically had a greater exposure to zoonotic disease, for example.

On theoretical level a scenario of the colonization of the world by modern humans through a large number of successive bottlenecks of small amplitude and a predominance of gene flow over limited distances (17) makes the most sense. All this fits in very cleanly in the Eswaran's hypothesis of demic diffusion (2) discussed in the foregoing Section. Eswaran has, of course, used the correlation of genetic diversity with distance as one of the tests of his thesis. The data also proved his model's prediction for a directionless pattern.

Genealogies and Genealogical Trees: Because everyone in the world is descended from the ancestral population, geneticists can infer some of its properties by analyzing the DNA of living people, and then working backward. Two parts of the human genome are particularly useful for this purpose. One is the Y chromosome, the only chromosome possessed by men alone. The other is mitochondrial DNA. As stated above, these are the only two parts of the genome that escape the shuffling of genetic material between generations.

In addition to their exempt status, the Y chromosome and mitochondrial DNA each have a special and surprising property of uniqueness. All men in the world today carry the same Y chromosome,and both men and women carry the same mitochondria. This means that all of today's Y chromosomes were inherited from the same, single source, a Y chromosome carried by an individual male who belonged to, or lived slightly before, the ancestral human population. The same is true of mitochondrial DNA; everyone carries the same mitochondrial DNA because all are copies of the same original, the mitochondrial DNA belonging to a single woman.The metaphor is hard to avoid - this is Adam's Y chromosome, and Eve's mitochondrial DNA. The ancestral human population, of course, included many Adams and Eves, indeed about 2,500 of each if the geneticists' calculations are to be believed. So how did it come about that just one man bequeathed his Y chromosome to the whole world and one woman her mitochondria?

It's a curious fact of genetics that one version of a gene, especially in small populations, can displace all the other existing versions of the same gene in just a few generations, through a purely random process called genetic drift (see above). Consider how this might work among surnames, which are passed on from father to son just like Y chromosomes.Suppose a hundred families are living on an island, each with a different surname. In the first generation, many of those families will have only daughters or no children at all. So in just one generation, all those families' surnames (and accompanying Y chromosomes) will go extinct. Assuming no new male settlers arrive on the island, the same unavoidable winnowing will happen each generation until only one surname (and Y chromosome) is left. This is what has happened with the human Y chromosome. Every Y

chromosome that exists today is a copy of the same original, carried by a single individual in the ancestral human population. The Y chromosomes of all the other Adams have perished at some point along the way when their owners had no sons (92). The same process of elimination has, of course, acted upon the mtDNA and made it universal among the current populations.

But despite all being copies of the same original, Y chromosomes are not identical. Over the generations, mutations have built up on the Y. The mutations are harmless but serve the invaluable purpose for geneticists of assigning the owners of Y chromosomes to different male lineages. The reason is that once a man has acquired a novel mutation in his Y chromosome, all his sons will carry that mutation, and no one else will. If one of the sons has a second mutation, all of his descendants will carry the two mutations. Each new mutation thus creates a fork on the family tree-between those who carry it and those who don't - and stands at the head of all the lineages beneath it. By looking at the most informative of the mutations on the Y chromosome, geneticists can assign every man to one lineage or another. Since there is only one Y chromosome, all these lineages or branches eventually coalesce to a single trunk, the Y chromosome of the original “Adam”. The same logic can apply to MDT and the original “Eve”.
Mutations get incorporated into the Y chromosome at a fairly steady rate, which enables geneticists to put a date on each branch point by counting the number of mutations down a lineage. And the lineages can be assigned not only a date but a geographical location. This is because human populations were expanding across the globe at the time the mutations of interest occurred but then, to a remarkable extent, people lived and bred in the same place they were born. So geneticists can impose the Y chromosome tree across the map of the world, assigning each of its forks and lineages to specific geographical regions.

Of particular help in defining the ancestral human population is the lineage of men that left Africa. A few men inside Africa, and all men outside it, carry a Y chromosome mutation known as M168. This means that modern humans left Africa sometime shortly after the M168 mutation occurred. Based on the mutation-counting method, one recent estimate is that M168 occurred 44,000 years ago. Genetic dates, however, generally come with a wide range of possible error. This one could range anywhere between 39,000 and 89,000 years ago.

As stated above, mitochondrial DNA can be used to construct genealogies of women just as the Y chromosome generates lineages of men.The women's lineages, like the men's, have all turned out to be branches from a single root, the mitochondrial DNA possessed by a single woman who lived in or before the ancestral human population. The mitochondrial genealogy of humankind has three main branches, known as Ll, L2 and L3. Ll and L2 are confined to Africans who live south of the Sahara. The L3 branch gave rise to a lineage known as M, and it was the descendants of M who left Africa. The mitochondrial Eve appears to have lived considerably earlier than the Y chromosomal Adam about 150,000 years ago - but that may reflect the difficulty of dating mitochondrial DNA, which gathers mutations more rapidly than does the Y chromosome.

Figures above depict the family tree of man as revealed by Y-chromosome DNA and mtDNA, respectively. The predominant haplogroups are indicated, along with their geographical areas of predominance. It must be remembered, however, that these figures represent the situation only in coarse outlines; the real picture is much more complex.

Genetic investigations of human population heavily depend on the statistical study of *Haplogroups*.

One way to think about haplogroups is as major branches on the family tree of *Homo sapiens*. These haplogroup branches characterize the early migrations of population groups. As a result, haplogroups are usually associated with a geographic region. If haplogroups are the branches of the tree then the *haplotypes* represent the leaves of the tree. All of the haoplotypes that belong to a particular haplogroup are leaves on the same branch. Both mtDNA and Y-DNA tests provide haplogroup information, but remember that the haplogroups nomenclature are different for each. Since the genealogy of mtDNA and Y-chromosome DNA are different, there are two types of genetic tree possible, and since they are independent of each other, the two trees may not always correspond. The term haplotype is a contraction of the term *"haploid genotype."* In genetics, a *haplotype* is a combination of alleles at multiple loci that are transmitted together on the same chromosome. *Haplotype* may refer to as few as two loci or to an entire chromosome depending on the number of recombination events that have occurred between a given set of loci. Analyzing mitochondrial and Y chromosome DNA from human populations has turned up hundreds of genetic markers (DNA sites having identifiable mutations specific to particular lineages). Since 1987 the data bank on human diversity has broadened to encompass the Y-chromosomes.

Ancestral Population Size: The Y and mitochondrial data can be made to yield another vital piece of information - the "effective" size of the ancestral population. The effective population is a statistical concept inferred by population geneticists from the amount of variation seen in samples of DNA. It is a large fraction of the real population size
- for humans, often considered to be about half. The effective size of the ancestral human population has long been estimated to have been around 10,000 individuals, but recent calculations, which mitigate a confounding factor in the earlier estimates, suggest the actual number may have been even smaller. An estimate based on the Y chromosome suggests an effective population size of just 1,000 men of re- productive age. Assuming the same number of women, this implies an "effective population" of 2,000, which is equivalent to a census-size population of a mere 4,000 individuals, or say 5,000 in round numbers.

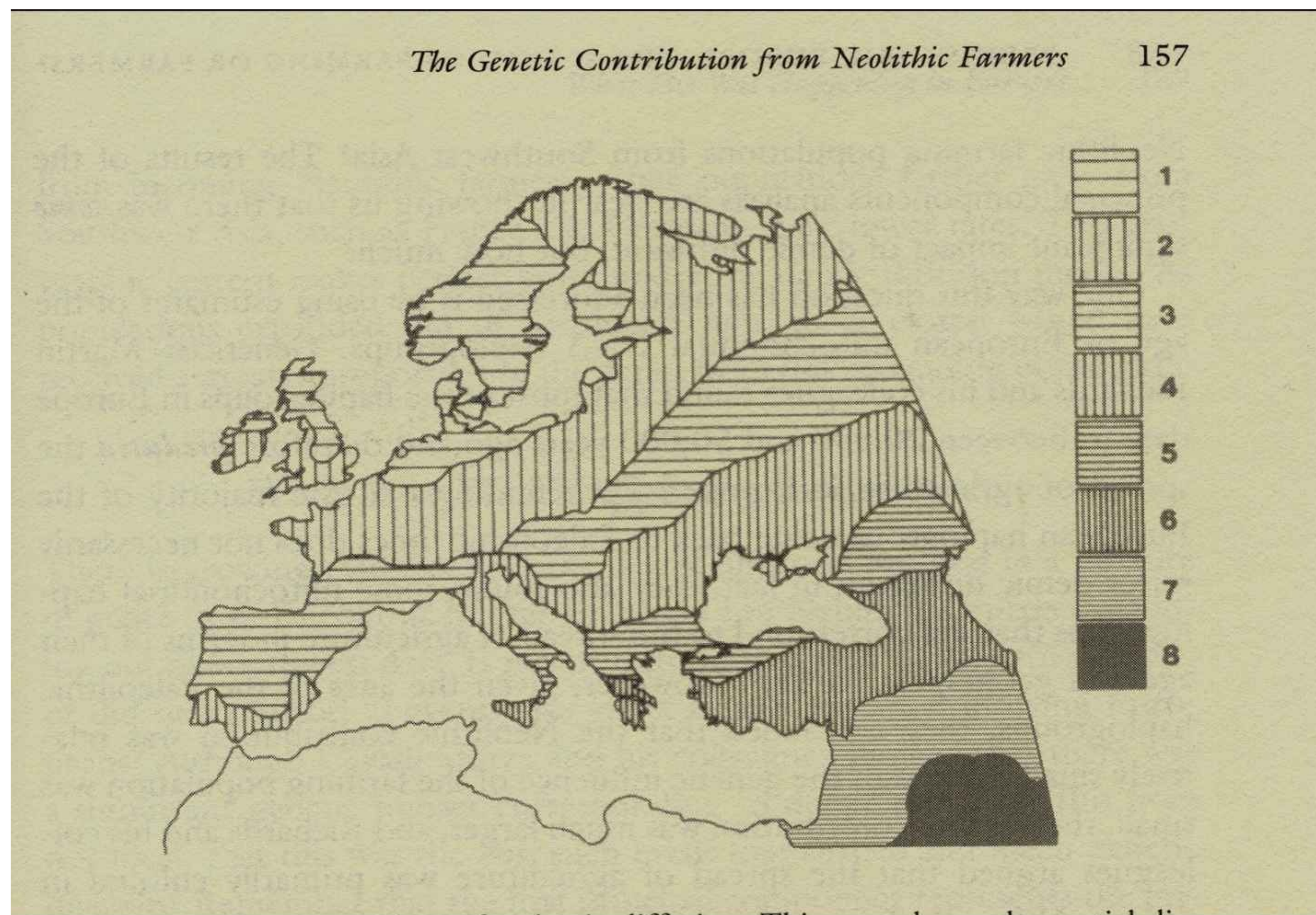
The first two branches of the Y chromosome genealogy, whose bearers are found only in Africa, have many sub-branches. This suggests the ancestral human population soon became quite spread out and diverse. There are other hints in the pattern of mutation that many Y chromosome lineages that once existed are now extinct. The ancestral population, in other words, may have suffered several calamities with widespread loss of male life.

Because foragers lived in groups, generally of 150 people or so who may have liked to trade with neighboring groups, a population as small as 4,000 or 5,000 people is unlikely to have been distributed over the whole continent of Africa. It would probably have had a much smaller range. The smaller the area, the more possible that at one time a single language was spoken. Archaeologists have not yet located this ancestral homeland. Given that its inhabitants would have been hunters and gatherers, they may have left little sign of their presence.

The size of ancestral populations is a controversial subject. The scenario painted above is confusing and logically stretched. In view of these inconsistencies and logical leapfrogging, some geneticists have rejected the very basis of modern human origins and their spread over the face of the earth, i.e. the Recent African Origin or Replacement model, and replaced it with various Multiregional Origins models or a wavelike dispersal (still originating in Africa) on the crust of which all the accumulated genetic changes took place. These models will be discussed in the next Section. For now, we will

focus our attention on the broadly acceptedmodel of Recent African Origin and Replacement of all previous populations.

Demic Diffusion : The diffusion of human behavioral traits can pass from one group of population to the next through cultural diffusion. The people stay where they were and do not move; they pass on new behavior and knowledge through a relay process. The passing of genes between two population groups, however, cannot happen in this fashion; humans must move from one community to another to transfer their genes. This process is known as *demic diffusion (demic* refers to *demes,* which are local breeding populations) and it de



An example of Synthetic Map, representing the genetic evidence for demic diffusion of Neolithic farmers from South-West Asia into Europe. It shows the order of the spatial distribution of the first principal component of

genetic variation component scores from one extreme to the other. There is a clear gradient from Southwest Asia into Europe in a northwest orientation, corresponding to

a different genetic composition. Source: L. L. CavalliSforza and F. Cavalli-Sforza, *The Great Human Diaspora*

pends on the movement of actual people, as opposed to behavior, across space. This model focused

on the migration of people following population expansion. As an example of such diffusion is the expansion of agricultureal populations in SouthWest Asia into Europe. As their population increased in size, they needed to expand in space to meet the resource needs of a growing population and as they expanded, they physically moved farther and farther where they genetically mixed with the preexisting hunter-gather populations. Such population expansions can be traced through the determination of genetic distances at appropriate intervals.

The study of demic diffusion can, however, get complicated if there are more than a handful of populations in an analysis. Genetic distances need to be computed between all pairs of populations. In a study of four populations, for example, there would be six genetic distances - one between each pair of populations. If we were looking at five populations the number of comparisons would increase to ten genetic distances, and if we were looking at ten populations, we would have forty-five genetic distances. As the number of distances becomes larger, it becomes harder to look at a table of numbers and easily see underlying patterns of relationship. For tunately, there are mathematical methods that can reduce a multidimensional plot to fewer variables. These methods are mathematically complex, but they essentially reduce data into a reasonable form that we are capable of drawing and interpreting. We could squeeze the distances down into a one-, two-, or three-dimensional picture, and this is the principle behind the *Principal Component Analysis* and constructing the *Synthetic Maps*, discussed below.

Principal Components Analysis and Synthetic Maps: Principal components analysis allows the researcher to find common patterns of correlation among the frequencies of different alleles in various populations under study. It allows us to reduce the number of dimensions of the gene space, using in an optimal way the available statistical data. PC analysis is done by computer programs of which there are many versions. Basically, each Principal Component is a string of numbers, one per population that summarizes all the information provided by all the genes studied. A PC comes attached with a percentage value, which measures the proportion of information that it explains. Naturally, the most important PC is the one that is most informative, i.e. the one that has the highest percentage of information. This PC is called the First Principal Component. The Second Principal Component extracts a little less information but this is information not contained in the first PC. The Third PC reiterates the process, and one can continue extracting PC until 100% of the total information has been retrieved. In practice, one rarely goes beyond three PCs because the vast majority of the information will have been extracted at that point. PCs are independent from each other, and that each PC extracts a different fraction of the statistical information available. In other words, each PC tells a different story. For each component, scores are computed for each population and then plotted on a map to allow a simple visual image of genetic variation across all alleles simultaneously. As they say, a picture is worth a thousand words.

The above figure show an example of the synthetic map constructed with the First P r i n c i p a l Component of the expansion of Middle East farmers into Europe. This classical analyses conducted by Cavalli-Sforza and his colleagues were based on ninety-five different alleles across a large number of European populations (19). In these representations, individual scores are collapsed into one of eight different intervals, each represented by a different graphic pattern (similar to the way temperature maps are shown in weather reports). The map shows a very clear pattern. The component scores change from a value of 8 in Southwest Asia to a value of 1 in Northwest Europe. (It doesn't matter which end has 1 or 8 since the direction and scale is arbitrary; what matters is the pattern of change over space). There is a regular spatial pattern, showing a change in component score along a

geographic gradient running in a southeast to northwest cline. This type of gradient is best explained by the expansion of a population with subsequent genetic mixing with indigenous populations.

As another example, the three maps reproduced below display sequentially the first, second, and third PCs of the world for the spread of modern humans, as constructed by Cavalli-Sforza and associates with eighty-two gene frequencies. The lines separating the different shaded areas connect equal values of the PCs. Eight different degrees of between human populations as they branch out and diversify, as well as the existence of genetic gradients, best explained by ancient migrations or demic diffusion, probably of Eswaran type (2). All these results were obtained through the study of protein polymorphisms. But in this age of molecular genetics, it is legitimate to ask whether variation in DNA sequence, and not just protein polymorphisms, supports the idea of human populations splitting off to generate subpopulations that spread across continents. Although ideally suited to the kind of data available at the time, this approach could not provide a time frame for the different components, so that the interpretation of the maps remained ambiguous.

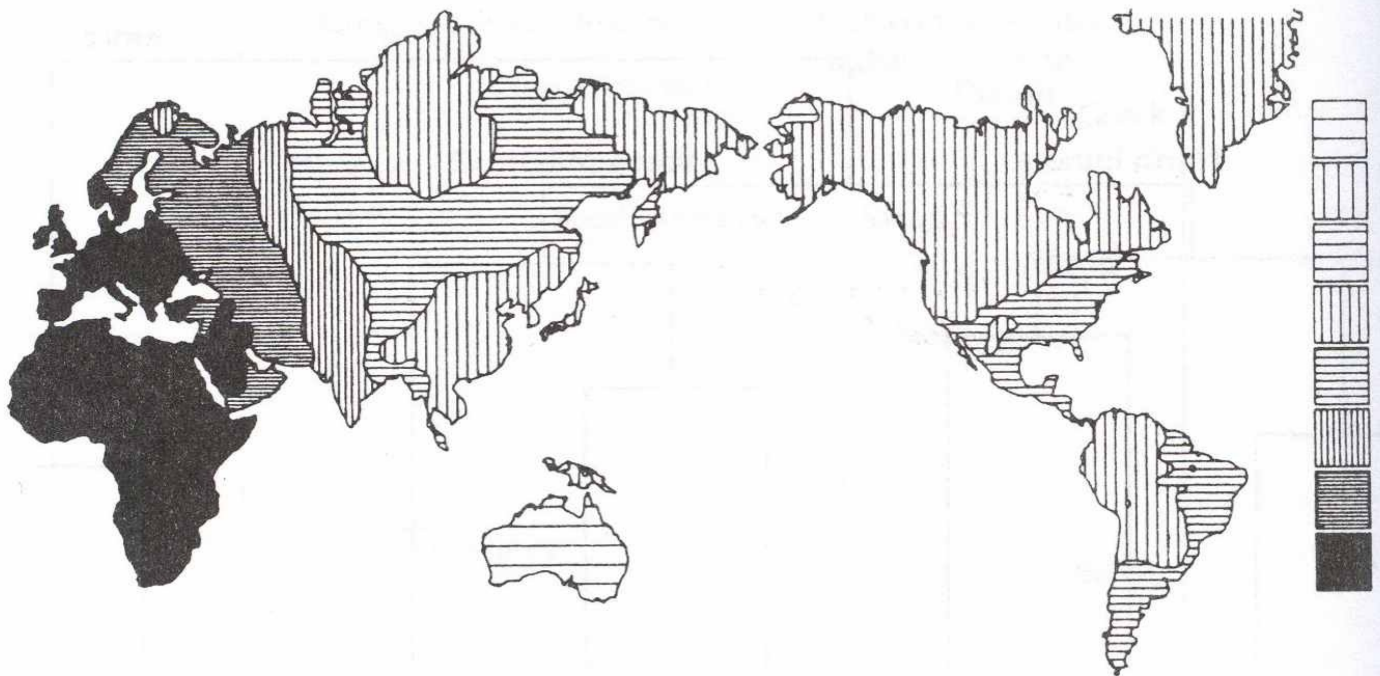


Figure 8.4 Map of the world's first principal component. (L. Luca Cavalli-Sforza, Paolo Menozzi and Alberto Piazza, fig. 2.11.1 from *The History and Geography of Human Genes*. Princeton, NJ: Princeton University Press, 1993. © 1994 Princeton University Press. Reprinted by permission of Princeton University Press.)

shading are shown. The top map represents the first PC, which includes nearly 35% of the total ob served variation. Two poles can be observed, one in Africa and one in Australia, with a notable gradient going from the West to the East or from East to West. The first PC map tells us two things: first, it shows the split between Africans and non-Africans. It should be noted that at this level of resolution, Africans are not distinguished from most Europeans

and Middle Easterners. Second, the clearly visible general west-east gradient is best explained by an cient migrations or expansions that brought people from one pole of the PC map to the other. It should be noted that synthetic maps are not directional, meaning that one cannot conclude from them whether human expansion took place from west to east or the other way round. Also, PC anal does not provide timing for these expansions. We will see later in this chapter how the question of the direc tion of migrations has been solved. The synthetic map in the middle represents the second PC, rep resenting about 18% of the total variation. Here, the poles are located in Australia and America. This map corresponds to the split of the Australians and New Guineans from the rest of the non-Africans. One can also see a gradient that now resolves Af rica and Europe into zones not visible in the first PC map, possibly indicating migrations in this part of the world as well. Finally, the third PC map (contain ing about 12% of the total variation), the one at the bottom of the figure, shows fine gradients in Africa and Eurasia and corresponds to the split between south Asians and north Eurasians. It also shows the intermediacy of North Africans between sub Saharan Africans and Europeans.

We saw above that the study of genetic distances and gene variation in space shows splits

Geography of human genes and correlation with lang

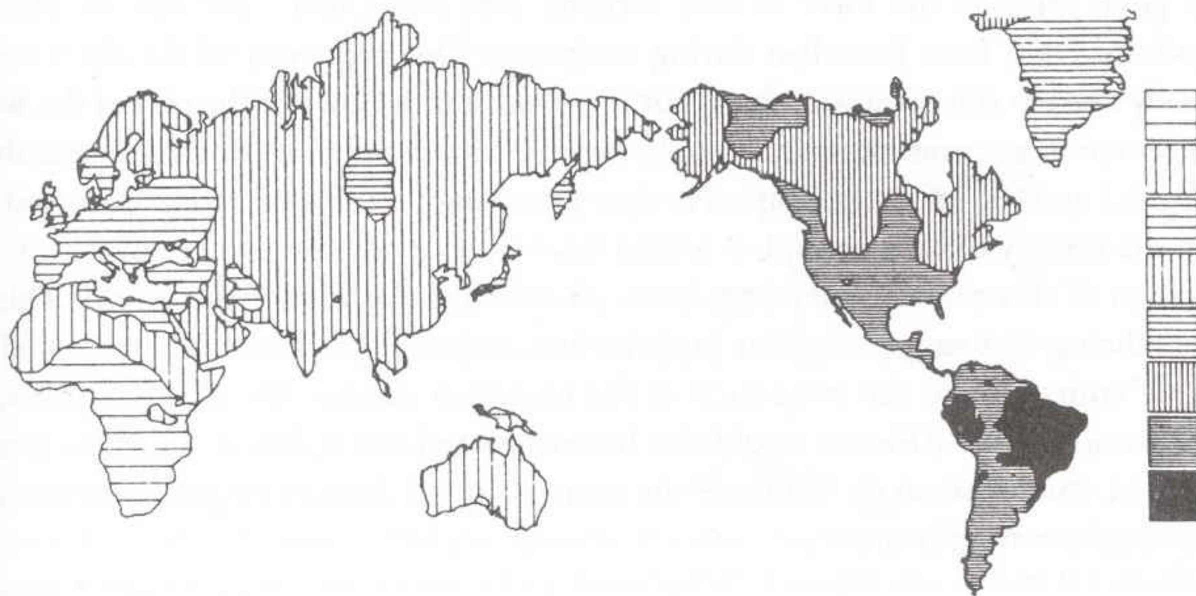


Figure 8.5 Map of the world's second principal component. (L. Luca Cavalli-Sforza, Paolo Menozzi and Alberto Piazza, fig. 2.11.2 from *The History and Geography of Human Genes*. Princeton, NJ: Princeton University Press, 1993. © 1994 Princeton University Press. Reprinted by permission of Princeton University Press.)



Figure 8.6 Map of the world's third principal component. (L. Luca Cavalli-Sforza, Paolo Menozzi and Alberto Piazza, fig. 2.11.3 from *The History and Geography of Human Genes*. Princeton, NJ: Princeton University Press, 1993. © 1994 Princeton University Press. Reprinted by permission of Princeton University Press.)

Maps of First (top), Second (middle), and Third (bottom)Principal Components (Cavalli-Sforza)

In summary, we can see some basic patterns when looking at human genetic diversity at a global

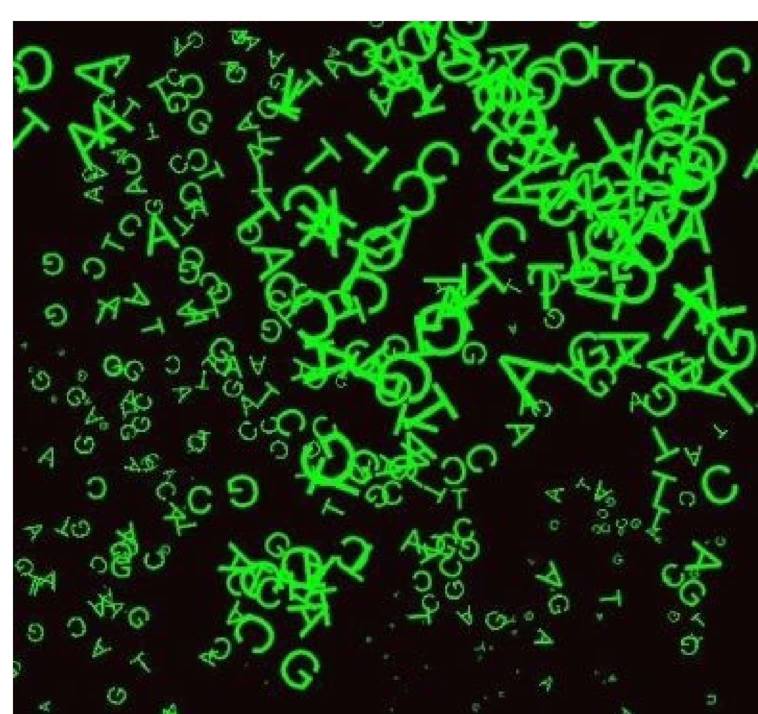
level. Eurasian populations are centrally located on the genetic distance maps, which reflect the fact that Eurasia is a geographic center connecting more distant regions. The population of subSaharan Africa is most similar to geographically proximate populations in the Middle East and North Africa. The populations of Australia, New Guinea, and the Pacific Islands are closest genetically to the population of Southeast Asia, which is also the closest geographically. Most of the patterns we see on a global level relate to geographic distance. The farther apart human populations are, the less gene flow between them, and the more genetically different they become. The patterns of genetic distance between human populations have also been shaped by the specific history of colonization and expansion, which in some cases has been geographically constrained. We can conclude, in a general sense, that Pacific Islanders came from Southeast Asia and that Native Americans came from Northeast Asia. At this global level, we are just beginning to peel back the layers of the palimpsest of human diversity. A more detailed examination will reveal the text that lies beneath this general picture.

Correlation of Human Genetic Diversity with Classification into Ethnic Groups and Races: When the genetic diversity of human populations is mapped out geographically, it is found that lations is mapped out geographically, it is found that 6% additional genetic variation is found when local populations on the same continent are compared, and an additional 10% when populations from different continents are compared. This seems at first surprising when we consider how easy it is to distinguish a Congolese from a Japanese. The explanation is that ethnic differences, such as the color of the skin and other observable morphological features, are associated with a small number of genes, which became differentiated because of their high adaptive value in response to different latitudes and climates. It also implies that genetic make of populations cannot form the basis of distinguishing one ethnic group from another or one race from the other. The issue of race and ethnicity is a very controversial but severely sensitive issue and is generally talked about in hushed voices.

In popular articles, genetic differences among human populations are often played down by stating, although usually without any reference, that about 85% of the total genetic variation is due to individual differences within populations and only 15% to differences between populations or ethnic groups. It has therefore been suggested that the division of Homo sapiens into any ethnic or racial groups is not justified by the genetic data. People the world over are much more similar genetically than appearances might suggest. Such statements seem to trace back to a 1972 paper by Lewontin in the annual review Evolutionary Biology (20). Lewontin analyzed data from 17 polymorphic loci, including the major blood groups, and 7 'races' (Caucasian, African, Mongoloid, S. Asian Aborigines, Amerind, Oceanians, Australian Aborigines). The gene frequencies were given for the 7 races but not for the individual populations comprising them, although the final analysis did quote the within population variability. The results are quite remarkable. The mean proportion of the total species diversity that is contained within populations is 85.4%. "Less than 15% of all human genetic diversity is accounted for by differences between human groups! Moreover, the difference between populations within a race accounts for an additional 8.3%, so that only 6.3% is accounted for by racial classification."

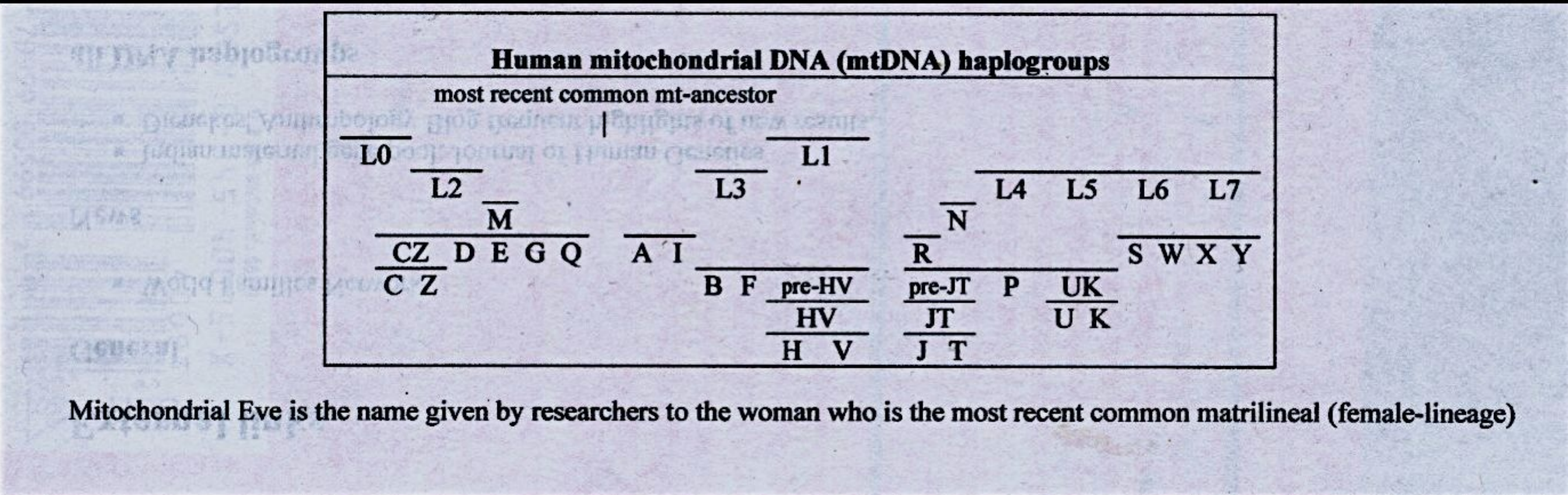
Lewontin concluded "Since . . . racial classification is now seen to be of virtually no genetic or taxonomic significance . . ., no justification can be offered for its continuance''. Lewontin included similar remarks in his 1974 book, *The Genetic Basis of Evolutionary Change*: "The taxonomic division of the human species into races places a completely disproportionate emphasis on a very small fraction of the total of human diversity". Edwards (21), however, strongly took issue with this

position by pointing out that these conclusions are based on the old statistical fallacy of analyzing data on the assumption that it contains no information beyond that revealed on a locus-by-locus analysis, and then drawing conclusions solely on the results of such an analysis. The ‘taxonomic significance’ of genetic data in fact often arises from correlations amongst the different loci, for it is these that may contain the information, which enables a stable classification to be uncovered. Edwards (21) bluntly states that it is not true that ”racial classification is . . . of virtually no genetic or taxonomic significance‘‘, it is not true that “two random individuals from any one group are almost as different as any two random individuals from the entire world‘‘, and it is not true that “two individuals are different because they are individuals, not because they belong to different races‘‘ and that “you can’t predict someone’s race by their genes”. Such statements might only be true if all the characters studied were independent, which they are not (21).

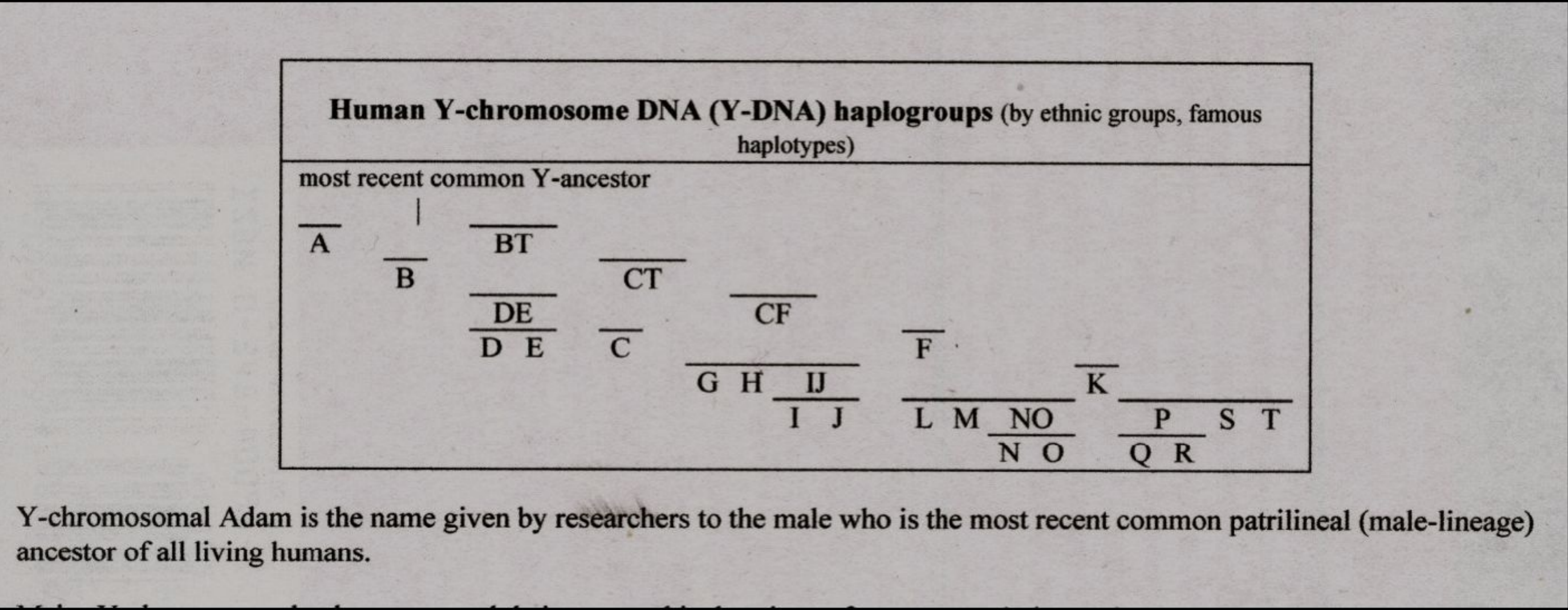


An Alphabet Soup of Human Genetics: Population geneticists often speak of haplogroups and haplotypes. As stated earlier, a *haplogroup* is a group of similar haplotypes that share a common ancestor with a single nucleotide polymorphism (SNP) mutation. A haplogroup consists of similar haplotypes and this is what makes it possible to predict a haplogroup from haplotypes. Y-chromosome and mitochondrial DNA haplogroups have different haplogroup designations. Haplogroups pertain to deep ancestral origins dating back thousands of years. In human genetics, the haplogroups most commonly studied are Ychromosome (Y-DNA) haplogroups and mitochondrial DNA (mtDNA) haplogroups, both of which can be used to define genetic populations. Haplogroups are assigned letters of the alphabet, A,B,C,L,M,N, etc, and refinements consist of additional number and letter combinations, such as R1b1. Human Y chromosome DNA (Y-DNA) hap-logroups are let tered A through T, and are further subdivided using numbers and lower case letters. Table below lists some of the various Y-chromosome DNA hap logroups in the form of a diagram. The next table is a highly simplified tree showing the most common mtDNA haplogroups. Over 300 mtDNA haplotypes have so far been identified in human populations.

The utilization of the haplotypes and hap logroups in tracing the ancestry of any particular population group is based on the assumption that there is little natural selection for or against a par ticular haplotype mutation which has survived to the present day and, consequently, genetic drift is the main driving force that affect the proportions of hap



Human mitochondrial DNA (mtDNA) haplogroups



subset of the genetic diversity originally present in the original population. So, as distance (and time) removed from the source lengthens, diversity diminishes, providing a means to follow population movements.

Y-chromosome Haplogroups: A Y-DNA haplogroup is defined as all of the male descendants of the single person who first showed a particular SNP (single nucleotide polymorphism) mutation. A SNP mutation, in turn, identifies a group who shares a common ancestor far back in time, since SNPs rarely mutate. Each member of a particular haplogroup has the same SNP mutation. The Ychromosome DNA is male-transmitted DNA, it carries many more nucleotides than mitochondrial DNA

does (tens of millions, as opposed to just 16,000), enhancing investigators‘ ability to distinguish one

population from another.
Specific Y-DNA Haplogroups are typically found in different regions of the world, and this is due to their unique population histories. In the process of spreading around the world, many populations with their special Y-DNA haplogroups became isolated, and specific Haplogroups concentrated in certain geographic regions. Today, scientists have identified certain haplogroups that originated in Africa, Europe, Asia, the islands of the Pacific, the Americas, and even particular ethnic groups. Of

course, haplogroups that are specific to one region are sometimes found in another, but this is generally due to later migrations. Their frequencies determine their primary or secondary role and helps to trace these migrations. Referring to the human Y-chromosome haplogroups listed in the above table, Haplogroups A and B are only found in sub-Saharan Africa. The defining mutations separating A and B from all other haplogroups are M168 and M294. These mutations predate the Out-of-Africa migration. The M168 mutation is the com

mon ancestral type of all early migration**Human Y-Chromosome DNA (Y-DNA) haplogroups, by ethnic groups**
and major haplotypes
out of Africa and this mutation is believed to have occurred 70,000 years ago . The

lotypes in a population. Genetic drift, in turn, is a random fluctuation caused by the randomness by which the population happen to pass their DNA on to members of the next generation of the appropri ate sex. In small, expanding populations, genetic drift causes the prevalence of a particular marker to change rather quickly; the marked geographical variations and concentrations of particular haplo types and groups of haplotypes therefore witness the distinctive effects of repeated Founder events followed by population separations and increases. Each time a smaller group split off, it carried only a defining mutations of D and E probably

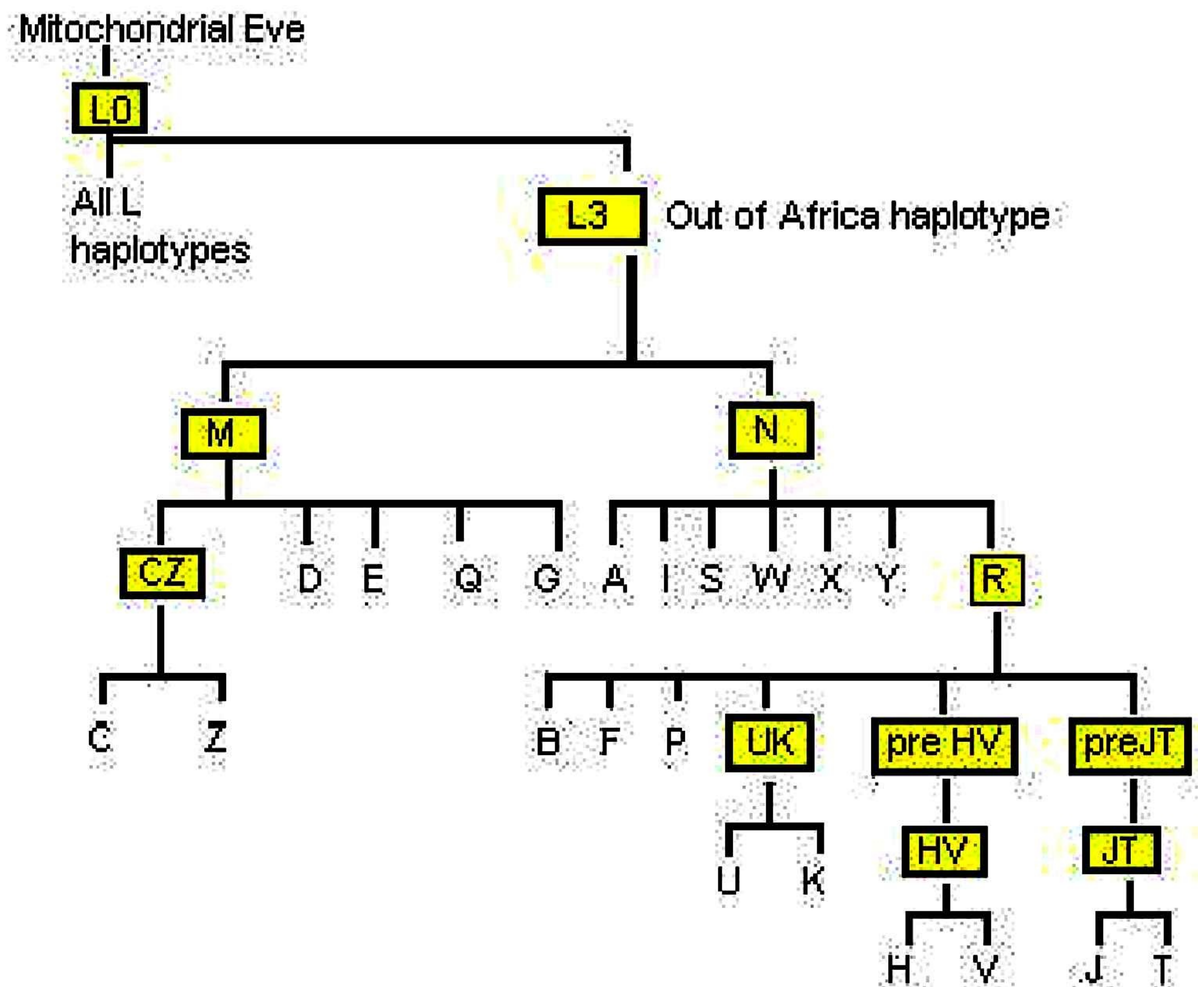
occurred some 50,000 years ago. The mutation that defines Haplogroup C to F may have occurred somewhat earlier, perhaps even as early as 55,000 years ago, after the first Out-of-Africa migration brought Homo *sapiens* to the southern coast of Southwest Asia. Haplogroup C, especially its C5 (M356) subclade and F (M89, M213), are found in South Asia. Haplogroup G (M201) originated in the Middle East or Caucasus, or perhaps further east as far as Pakistan some 30,000 years ago, and spread to Europe, probably with the Neolithic Revolution. It is found in many ethnic groups in Eurasia; of special interest to us is its presence in the Caucasus, the Iranian plateau, and Anatolia. Haplogroup G (M201) is a branch of Haplogroup F (M89), and is theorized to have originated, according to the latest thinking, in the Near East or South Asia, probably in the region that is now northern Pakistan, northern India, and Afghanistan. The haplogroup began to spread probably with the Neolithic Agricultural Revolution, or perhaps with the appearance of the early horse nomads of the Eurasian steppe.

In Pakistan, the haplogroup G is found at a rate of 10% to 20% among Pashtuns (ethnic Afghans), and

the Kalash in northern Pakistan, and at a lesser percentage among some other populations in Paki stan, India, and Sri Lanka, in cluding the Tamils. Around 11% of Turkish males are in hap logroup G. In Central Asia, G is found in small percentages in a belt extending from the Cauca

The bulk of Haplogroup R is represented in lineages R1a and R1b. R1a likely originated in the Eurasian Steppes, and is associated with the Kurgan culture and Proto-Indo-European expansion. It is primarily found in Central Asia, South Asia, and the Slavic peoples of Eastern Europe. R1b originated prior to or during the last glaciation, when it was concentrated in refugia in southern Europe; it is also found sparsely distributed among various peoples of Asia and Africa. Some form of R1b, perhaps R1b1* (P25), probably migrated westward to populate Western Europe around 35,000 years ago. Its subclade R1b1c (M269) is the haplogroup that is most commonly found among modern European

sus through the Central Asian steppes out to the Uyghurs of Xinjiang Province in western China. Haplogroup H(M69) probably occurred in South India some 30-40,000 years ago, and remains prevalent there and in Pakistan in low frequencies, spreading westwards in historical times. Haplogroup I is Europe specific, J is rather diffused, its J2(M172) sub-clade is spread around in Medeterranian basin, Turkey, central Asia, and South Asia. Haplogroup K(M9) probably originated in south-western Asia and spread widely to Africa, Eura-sia, Australia and the South Pacific and is not important in the ancestry of South Asian peoples.

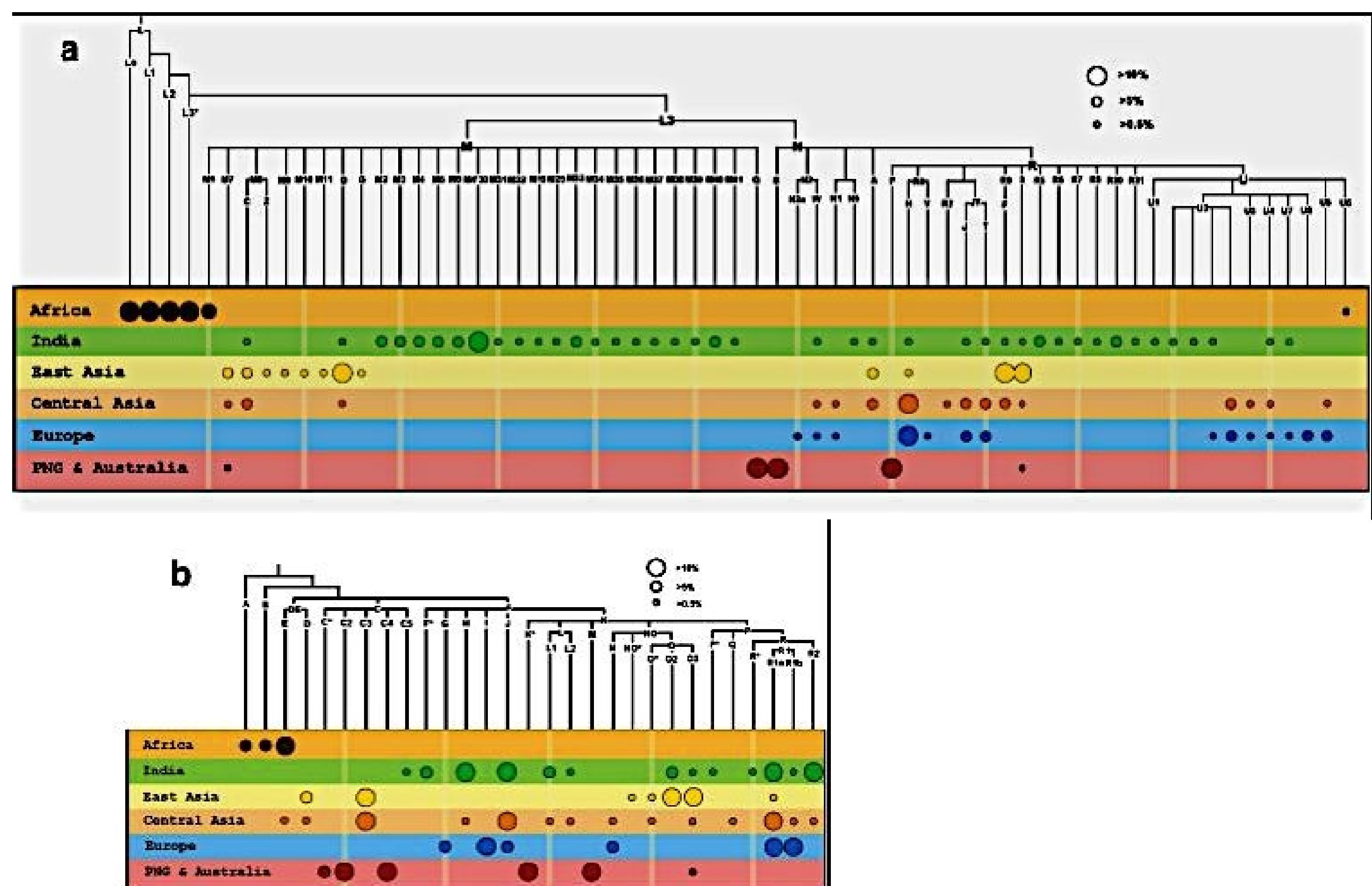


Mitochondrial DNA tree and the origins of various matrilineal haplogroups

Haplogroup L(M20) is mainly found in Pakistan but it is also found in lesser frequencies in south India, Central Asia, Southwest Asia, and Southern Europe along the coast of the Mediterranean Sea. The subclade of Haplogroup L are L(M11, M20, M22, M61, M185, M295) and are typical of Pakistan's population. Haplogroup M is importasnt for South-East Asia but not relevant to South Asia. Haplogroup N (M231) probably originated in Mongolia and spread both into Siberia, being the most common group found among the Uralic peoples. *Hap*logroup O (M175) is found at its highest frequency in East Asia and Southeast Asia, with lower frequencies in the South Pacific, Central Asia, and South Asia. Haplogroup P(M45) gave rise to groups Q and R(M207, M306), and is rarely found in its undifferentiated stage. It probably originated in Central Asia or the Altai region. Haplogroup Q (MEH2, M242, P36) also originated in Central Asia, migrating east to North America. populations, especially those of Western Europe. Haplogroup R2 originated in South Asia and is generally found in Central Asia, Turkey, Pakistan, and India. Haplogroup T (formerly Haplogroup K2) (M184, M70, M193, M272) is found in Africa (mainly Afro-Asiatic-speaking peoples), the Middle East, the Mediterranean, South Asia.

Major mutations and the related Yhaplogroups, in relation to South Asia are:
Groups with mutation M89 (occurring ~45,000 years ago): Haplogroup F (M213); Haplogroup G (M201).

Groups with mutation M9 (occurring ~40,000 years ago): Haplogroup L (M20); Haplogroup O (M175).
Groups with mutation M45 (occurring ~35,000 years ago: Haplogroup Q (M242); HaplogroupR1a (M17); Haplogroup R2 (M124).
After years of focus on the maternally inherited mitochondrial DNA, the paternally inherited Y chromosome is now providing complementary data, and comparisons between the two are yielding surprises. And the recently published human genome sequence, with its catalog of human genes and listing of the many variations seen in our DNA sequence, offers a new wealth of data for detecting the movement as well as the evolution of our ancestors. It is up to us to reconcile this data with the archaeological and climatologically record in order to fill in the picture.
mtDNA Haplogroups: The mtDNA haplogroups, like the Y-DNA haplogroups, are named according to capitalized letters of the alphabet. Examples of mtDNA haplogroups include H, L, M, A, etc. Each of these major haplogroups, or clades, can have subgroups, or subclades. Subgroups have a numeric name which follows the haplogroup name. For example, haplogroup E has two subgroups called E1 and E2. Subclades can also have subgroups, which are noted with lower-case characters, such as E1a or E1b.
Analysis of mtDNA variation in African populations reveals the most ancient of all human continent-specific haplogroups (22,23). For example, the sub-Saharan African mtDNAs belong largely to a mtDNA supercluster L, further divided as L1, L2 and L3 (10). *L3* is at the root of nearly all mtDNA diversity found outside sub-Saharan Africa,



The summary and distribution of Global mtDNA (a) and Y chromosome (b) topology. The lower panel (b) shows the Y chromosomal clades and their frequency in Eurasia, where subclades F*, H, L1 and R2 are autochthonous to India and outside India are found at low frequencies only in Central Asia. The upper panel (a) depicts the mtDNA clades and their

frequency in Eurasia. African-specific branches of the tree are simplified to show only the very basic line-ages and identify the root L3 for the pan-Eurasian founder lineages M and N (including R). The region specificity of different haplogroups is shown in color as indicated.

while nine mtDNA haplogroups (H, I, J, K, T, U, V, W and X) comprise about 95 per cent of the western Eurasian mtDNA pool, including Mediterranean Africa. MtDNA haplogroups M, B, F and A are specific for Mongoloid populations.

A closer look at mtDNA haplogroup M and N(together with R) is important. Travelling up the human mtDNA phylogeny from the root, corresponding to what has, often rather confusingly, been identified with 'mitochondrial Eve', one passes through several biand trifurcations until one reaches the first multifurcation node, the root of haplogroup L3 (Figure below). This root gave rise to many (successful) descendant haplogroups, perhaps reflecting some colonization event or local population growth 80,000-90,000 years ago. This event probably occurred in the Horn of Africa because the richest branching around the L3 node is reflected in modern Ethiopian samples, in contrast to the somewhat narrower mtDNA pools of other parts of sub-Saharan Africa.

Two splinters of this basal L3 variation, haplogroups M and N, cover the mtDNA pool of all nonAfricans. Haplogroup N almost immediately diverged further to give rise to haplogroup R (Figure above). All over Eurasia, America, Austral-asia and Oceania descendants of all three corresponding root haplotypes (M, N and R) can be found, with only a few more impoverished regional exceptions. Therefore, these three root types (which originated somewhere between East Africa and India) must have been the founder types for the Eurasian settlement *ca*. 60,000–65,000 years ago (24,25). Not only are the descendants of these founders ubiquitous outside Africa but also their numerous basal sub-branches are more or less specific to the major geographical regions.

M is an enormous haplogroup, spanning many continents. It is more common among the peoples of Asia while N is more prevalent among the populations of Europe. M constitutes almost half of the mitochondrial types in India, somewhat less in Pakistan and even lesser in Central Asia and Iran. However, going eastward, M represents close to 100 percent in the population of Australia. M is believed to have originated in South Asia (13) some 60,000 to 75,000 years ago. Due to its great age, haplogroup M is an mtDNA lineage which does not correspond well to present-day ethnic groups, as it spans Siberian, Native American, East Asian, Southeast Asian, Central Asian, South Asian, Melanesian as well as Ethiopian, Somali, European, and various Middle Eastern populations in lesser frequency.

Haplogroup M developed into several subgroups, such as M1, M2, M3, etc. M1 seems to be confined to Africa, especially Ethopia, while other subgroups are widely distributed in Asia. The deep roots of M phylogeny clearly establish the antiquity of Indian lineages, especially M2, as compared to Ethiopian M1 lineage and hence, support an Asian origin of M macrohaplogroup. As will be shown later, among the descendants of M, the lineages M2, M3, M4, M5, M6, M18 and M25 are exclusive to South Asia, with M2 is reported to be the oldest lineage on the Indian subcontinent (26).

It is interesting to note that the gradient of the presence of M is not from west to east; instead, the genetic diversity of M is much greater in India, less in Pakistan, still less in Iran, and the least in Ethiopia. This geographical distribution has led some to believe that the lineage M originated in India and then spread backwards to east Africa (28). The supposed Indian expansion to the west also reached northern areas through Punjab and the Pashtun country since a subgroup of M, the M4 clade,

has been also detected in Central Asia (28). The given distribution, however, shows that the people who carried the M lineage never made it into the interior parts of the Middle East and then to Europe. Other scientists explain this anomaly by postulating a bottleneck through which M was lost from the genetic mix of the subsequent expansion in population in Europe.

Just like M, haplogroup N is derived from the ancestral L3 haplotype that represents the 'Out of Africa' migration. It is the ancestral haplogroup to almost all European and Oceanian haplogroups in addition to many Asian and Amerindian ones. It is believed to have arisen in West Asia at a similar time to haplogroup M. Its derived haplogroups include the macro-haplogroup R who gave birth to several different subgroups, some of which exhibit specific geographic homelands. One of them is U. The figure below shows the relationship of M, N, R., and U lineages. The old age of Haplogroup U (55,000 years) has led to a wide distribution of its descendant subgroups that harbor specific European, northern African, South Asian, Arab, northern Caucasus Mountains and the Near East clades. Out of the several sub-groups, haplogroup U7 is of most relevance to Iran, Pakistan, and India. Many European populations lack haplogroup U7, but its frequency climbs over 4% in the Near East and up to 5% in Pakistan, reaching nearly 10% level inIranians. In India, haplogroup U7 frequency peaks at over 12% in Gujarat, the westernmost state of India, while for the whole of India its frequency stays around 2%.

There is now growing evidence that the richest basal variation in the three founder haplogroups M, N and R is found along the southern stretch of Eurasia, particularly in the Indian subcontinent (29,30). Although Southeast Asia has been less comprehensively analyzed to date, recent first results indicate a similarly high basal diversification in this region (24). This suggests a rapid colonization along the southern coast of Asia, reaching Sahul *ca.* 60,000 years ago. The expansions northwards to fill the heartland of the continent occurred later, *ca.* 45,000 years ago, when technology and climatic conditions enabled the exploration of the interior of Eurasia. One of the more marginal extensions eventually led to the peopling of Europe (31).



As is evident from the above, driven by fast mutation rate and lack of recombination, distinctive clusters of mtDNA lineages have emerged during the last tens of thousands of years. Low overall population density during Paleolithic and vast geographic distances favored the isolation of human populations and thus played an important role in secluding the differences arisen in DNA lineages. Since the present day mtDNA variability is highly continent-specific, one can reliably distinguish between mtDNAs of eastern Asian, European, subSaharan African, or now South Asian origin. Haplogroups A, B, C, D, E, F, G and M embrace the majority of the lineages described for Asia, Oceania and native Americans. The geographic distribution of derived branches of these haplogroups has shed light on crucial aspects of human history, such as the probable origin and approximate dating of migrations into the New World and Polynesia and quantitative estimations of the relative Paleolithic and Neolithic contributions to the extant European mtDNA diversity. Within individual geographical regions, however, this kind of clear demarcation does not exist and a variety of several

mtDNA haplogroup are to be found intermixed in an amazingly intricate fashion. A number of these admixtures may be a result of recent migrations.

Concluding Remarks: We are the end result of over a billion years of evolutionary process, and our genes carry, as Spencer Wells called them (58), the seams and spot-welds that reveal the story. It is not the code

itself that delivers the message, but rather the differences we see when we compare DNA from two or more individuals. In other words, the identical bits of our genetic code tells nothing about our history, it is the differences that speak, and this is what we study. It was clear from the early on that the majority of the genetic differences in humans were within populations – around 85 percent of the total. A further 7 percent served to differentiate populations within a ‘race‘, such as the Greeks from the Swedes. Only 8 percent were found to differentiate between human races. Almost all our DNA is the same from person to person. But interwoven in a small fraction are telltale differences. This small proportion of the genetic variation that distinguishes between human populations is the basis of all research in the origin and spread of modern humans.

Until very recently, geneticists could only dream of using the diversity of our genes to trace the detailed history of how we spread over the face of the earth. The reason for their pessimism was that the majority of the genes they examined shuffled themselves around at each generation and was common to most populations anyway. Their task was like trying to reconstruct a previously played card game from the pack of cards *after* it has been shuffled. So it was nearly impossible to draw an accurate genetic family tree going back even a few hundred years, let alone back to the beginning of our species. However, the use of gender-specific gene lines, the so-called Adam and Eve genes, has in the last fifteen to twenty years changed all that.

Over a period of nearly 150,000 years, a number of tiny random mutations have steadily accumulated on different human DNA molecules, the molecules that have been passed down generation after generations. Mutations are thus a cumulative dossier of our own prehistory and we can use this record to reconstruct a genetic tree of our ancestors and ourselves. Thus, DNA analysis of present populations around the world can provide us with a map of our wanderings and give us a rough idea of the dates. Of course, every journey must have a beginning, and this one is no exception. It begins with the scientific effort to make sense of human diversity and it is often not an easy task. Although it is simple to draw on the back of an envelope a recent mtDNA tree with only a couple of mutations to play with, the problem becomes much more complex when dealing with the whole human race, with thousands of combinations of mutations. So computers are used for the reconstruction and the whole task assumes a shape of statistical endeavor.

Many regional human gene trees have now been fitted together, like a large jigsaw that is started by assembling the edges using certain clear landmarks. In this way, a picture of the Adam-andEve gene lines spreading from Africa to every corner of the world has been pieced together over the last decade. It has got to that satisfying point, as with jigsaws, when the whole structure suddenly links up and takes shape; the remaining pieces, though many, are now being placed on the tree and on the map with increasing ease and speed. The pace is now so rapid that people working at the cutting edge on one geographic region may still be unaware of breakthroughs in another region. The whole branching tree can now be laid flat on a world map to show where our ancestors and their gene lines traveled in their conquest of the world. The new knowledge has resolved some of the apparent

paradoxes thrown up by the contrast between the cultural and biological stories of the last 150,000 years. We can now even start to hang the regional human fossil relics of that period in their correct places on the genetic tree of life.

Not only can we retrace the tree, but also by taking into account where the sampled people came from, we can see *where* certain mutations occurred - for example, whether in Europe, or Asia, or Africa. What's more, because the changes happen at a statistically consistent (though random) rate, we can approximate the *time* when they happened. This has made it possible, during the late 1990s and in the new century, for us to do something that anthropologists of the past could only have dreamt of: we can now trace the migrations and dispersals of modern humans around our planet.

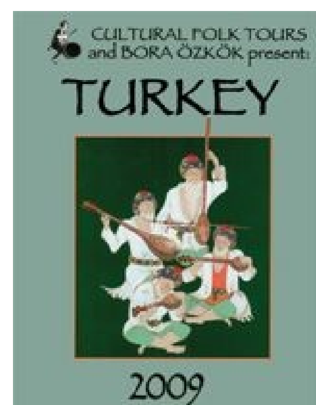
In the past several years, an increased availability of data on human genetic variation, coupled with advances in theoretical population biology and a heavy doze of statistics, has allowed us to examine human demographic history from another, non-traditional perspective. These attempts have addressed some of the earlier problems and have provided an independent base for examining several aspects of human evolution and dispersal which were not amenable to the traditional disciplines of archaeology and anthropology. However, while attempting to solve some problems, archaeogenetics has created others. It was soon realized that the application of genetics in the service of man’s ancient history was neither methodologically simple nor theoretically operative in isolation. Additionally, genetic hypotheses about the past are largely a reflection of the paleo-demographic models assumed. Understanding changes in patterns of DNA sequence among people requires a multidisciplinary perspective embracing evolutionary ecology, archeology, and paleoanthropology. This interface is indeed being provided in recent years as the newly emerging fields of investigation, such as behavioral ecology, demography, and population genetics find a fresh interface with theory governing mate choice and sexual selection. For most of the 20th century, the fields of genetics, linguistics, and archeology evolved in parallel, but in the past 20 years a substantial change, referred to as the "Emerging Synthesis", has been attempted. This is leading to a deeper conceptual unification of studies centering human evolution and dispersal. With the availability of sharper tools and attestable theories, we are now set to explore the movements of human populations. Despite the great potential of population genetics to untangle the plot of our being, and despite the great enthusiasm expressed in the above, a note of caution is warranted. One thing everyone agrees on is that reading our history in our genes is fraught with pitfalls. Getting lots of data has become easy, but working out which sequences to use, whom to sample, and how to identify the genetic legacies of natural selection, migration and population bottlenecks is extremely tough. Even relatively simple analyses involve assumptions and educated guesswork and can take thousands of hours of computer time.

The application of genetics in studying human populations, their dispersal and migrations, and their expansion and contraction to trace the history of human colonization is a statistical endeavor and it represents a considerable challenge. A reasonably detailed description would include (1) the times of major population splits, (2) the effective sizes of each distinct population and/or a list of major bottlenecks and (3) times of major admixture events, when previously distinct populations met and the contributions of the distinct populations to the new hybrid population. Even a complex population-based history does not fully describe migration patterns, since isolation by distance can also be important. DNA is passed down through generations in linear segments whose boundaries are determined by meiotic crossovers. Modeling the segment-by-segment inheritance of genetic material is technically challenging even assuming simple demographic scenarios (32). Adding modern and ancient population subdivision makes computations more complex and introduces the problem of

choosing amongst a very large number of possible split and merger scenarios (24,33).

Genetic diversity of living humans is more like a palimpsest than a complete erasure; it reflects a mixture of past events, both recent and distant in time. Throughout written history and prehistory, human populations have moved into new territories, mated with neighbors close and far, changed in size, and undergone changes that affected genetic diversity. What we see in the world today is the combined outcomes of all such events, large and small, global and local, across the span of time. We see a composite image, one that can be analyzed by peeling away the layers of the palimpsest to reveal information on the history of human population. The point here is that the patterns of genetic variation that we see in the world today were not caused by any single event, but instead reflect a palimpsest, a mosaic of events that occurred at different times and in different places. As such, our genetic diversity more closely resembles a partially painted wall, with visible images both old and new, rather than a newly painted wall where all past events have been erased. Our goal, difficult though it often is, is to peel away the different layers to determine *which* events affected current) genetic variation, and *how*. Just as historians have methods to peel away the different levels of text in a palimpsest, anthropologists and geneticists have ways of doing the same thing with genetic variation. (*John H. Relethford*).

IV.2. Genetic Legacy of the West



There is strong evidence for an intimate genetic interaction of various population groups of Pakistan with those of the regions to its West and the Northwest, i.e., I ran, Central Asia and, by extension, the Near East. These populations are, therefore, of particular interest to us for addressing the question of the peopling of Pakistan and investigating the genetic make up of its people. This region, broadly defined as Middle Asia, is characterized by a patchwork of diverse physical types of populations with complex boundaries and gradients and by the coexistence of several language families (e.g., Indo-European, Semitic, and Turcik) as well as some relic linguistic outliers. Middle Asia has played a pivotal role in the history of humankind in Asia as well as in Europe, witnessing numerous waves of migration of different peoples at different times. Pakistan has been an active participant in this churning of humanity.

As postulated in the previous two sections, the southern part of this region, that is, the area around Persian Gulf generally, was probably one of those 'maturation areas' where Homo *sapiens sapiens*,ens sapiens, 100,000 years ago (34,27), or even earlier, inhabited, matured, and mutated for quite some time before expanding to the surrounding areas. Genetic evidence indicates that southeastern Iran was located at the crossroads of major population expansions in the middle Pleistocene and it is probably from this region that modern humans migrated to the rest of the world, including the Levants, North Africa, and Europe to the west, Central Asia to the North, and southern Pakistan and India to the East (36). The precise migration routes taken by early humans from southern Iran or the Persian Gulf area to the northern regions can only be speculated but the spread of humans from this area to Pakistan is almost a certainty: this dispersal must have occurred along the coastline with a short pause of a

few thousand
years in the Indus Delta and then

forward to peninsular India and northward along the Indus system to Pothwar and the Hindu Kush. These events genetically connect Pakistani populations with those of Iran and Central Asia on one side and those of India on the other side.

Apart from the deep rooted genetic links between the populations of Pakistan and those of southeastern Iran, referred to above, we know for certain that a large number of human migrations occurred from Central Asia to Pakistan in historical as well as in prehistoric times and these events must have genetic consequences for the peoples of Pakistan. There is no doubt that the interaction of

different populations within this region was intense and sustained. This is indicated by the spreading of agriculture, animal domestication, and sedentary living style all along the southern area, starting from Mesopotamia to the western edges of Sindh. The geography of the region dictates that there must be population movements in the Stone Age also. We are primarily concerned here with the deep rooted genetic links of the current populations of Pakistan with those of Central Asia, Iran, and possibly the Near East. However, we cannot ignore the movements of peoples within this region in postPleistocene era. First, it is often not possible to discern the deep rooted genetic links from the more recent influences, partly because of the lack of finegrained research in any part of this region. Second, the genetic links of recent origins between different parts of this vast region looms very large in all populations of this area. Third, the issue of the Aryans is important in the history of the whole region, particularly that of Afghanistan, Iran, Pakistan, and India.



Focus on Central Asia: The evolutionary history of modern humans has been characterized by range expansions, colonizations and recurrent migrations over the last 100,000 years. Some regions of the world that have served as natural corridors between landmasses are of particular importance in the history of human migrations. Central Asia is probably at the crossroads of such migration routes. Located in the Eurasian heartland, it encompasses a vast territory, limited to the east by the Pamir and Tien-Shan mountains, to the west by the Caspian Sea, to the north by the Russian taiga and to the south by the Iranian deserts and Afghan mountains. The role of Central Asia in both the early spread of modern humans out of Africa and the more recent settlement of differentiated populations is not precisely known (95,96). For example, it remains unclear as to whether this region harbored a Paleolithic ‘maturation phase' of modern humans before giving rise to waves of migration, resulting in colonization of the Eurasian continent or whether it has served as a meeting place for previously differentiated Asian and European populations following their initial expansions (97).

Central Asia entered the archaeological record of Pakistan as early as the fourth millennium BC when we detect several common cultural traits, such as decoration on pottery, between northern Baluchistan and southern Tukmenia. These cultural contacts continued till very recent times. There were a number of migrations of pastoral nomads into northern Pakistan in historic times and no doubts in the

prehistory of the region. In the thirteenth century the Turco-Mongol empire lead by Genghis Khan became the largest of all time, from Mongolia to the Black Sea on one end and to the eastern borders of Pakistan on the other side. All these movements of populations resulted in a considerable ethnic diversity in Central Asia with Indo-Iranian speakers living as sedentary agriculturalists and Turkic speakers mainly living as traditionally nomadic herders. This also opened up an enhanced level of genetic mixing between the populations of Central Asia and those of Pakistan and Iran. Taken together the ancient peopling of Central Asia, Iran and Pakistan, this intricate demographic history shaped patterns of genetic variability in both the regions in a complex manner.

Central Asia is a territory of vast contrasts, with most of the land occupied by high altitude tracts or vast cold deserts, both unfavorable for large and stable human settlements. However, the river basins have been occupied since early times, and the steppes have offered a good land for an itinerant pastoral economy. Central Asia is often regarded as a borderland between the East and the West, without a unique, particular genetic history. From the point of view of the history of Pakistan, it is a very important territory, perhaps more so than India or even Iran, if we are trying to understand the cultural and genetic consequences of complex cultural phenomena such as acculturation, assimilation, and syncretism; overlapping of economies, languages, and ways of life; and migrations, expansions, and conquests. It is an important territory for its genetic contribution to the populations of Pakistan. It is also important for the understanding of genetic history of northern India because it is through these peoples that most of the ‘western’ genetic markers were transmitted to the Indian population, the peoples of Pakistan playing an intermediary role.

An intimate cultural and genetic contact between the populations of Pakistan and those of Central Asia has been possible because of the favorable geographical features of the region. The unending separate mountains have never proved to be an impediment in the movement of men and beasts, and a large number of passes have acted like funnels to guide the movements of humans throughout history. This is in stark contrast to the situation with Iran and India. A series of vast desert lands separate Baluchistan from Iran and the communication between the two was possible only periodically when ecological conditions were favorable for human survival in these deserts. Similarly, the communication with India was hindered for the presence of a formidable desert, the Thar, between the two. Here too, the communication between these two areas was possible only through two narrow corridors, one in the north along the foothills of the Himalayas, and one in the south, through the swamps of Kutch and along the coast.

A detailed knowledge of the peopling in this vast region would therefore greatly improve our understanding of range expansions, colonizations and recurrent migrations, including the impact of the historical expansion of eastern nomadic groups that occurred in Central Asia. Because of an intimate relationship of the peoples of Central Asia and those of Pakistan from antiquity, the study of the genetic make-up of the various populations in this region is of particular importance. It is the eastward movements and migrations of these people which to a large extent determine the genetic make-up of the population of Pakistan and to some extent that of northern India. However, despite its presumable importance, little is known about the level and the distribution of genetic variation in this region. Contrary to its relatively recent history, the Stone Age story of this region is not well known, nor is the role of Central Asia in early human evolution well established.

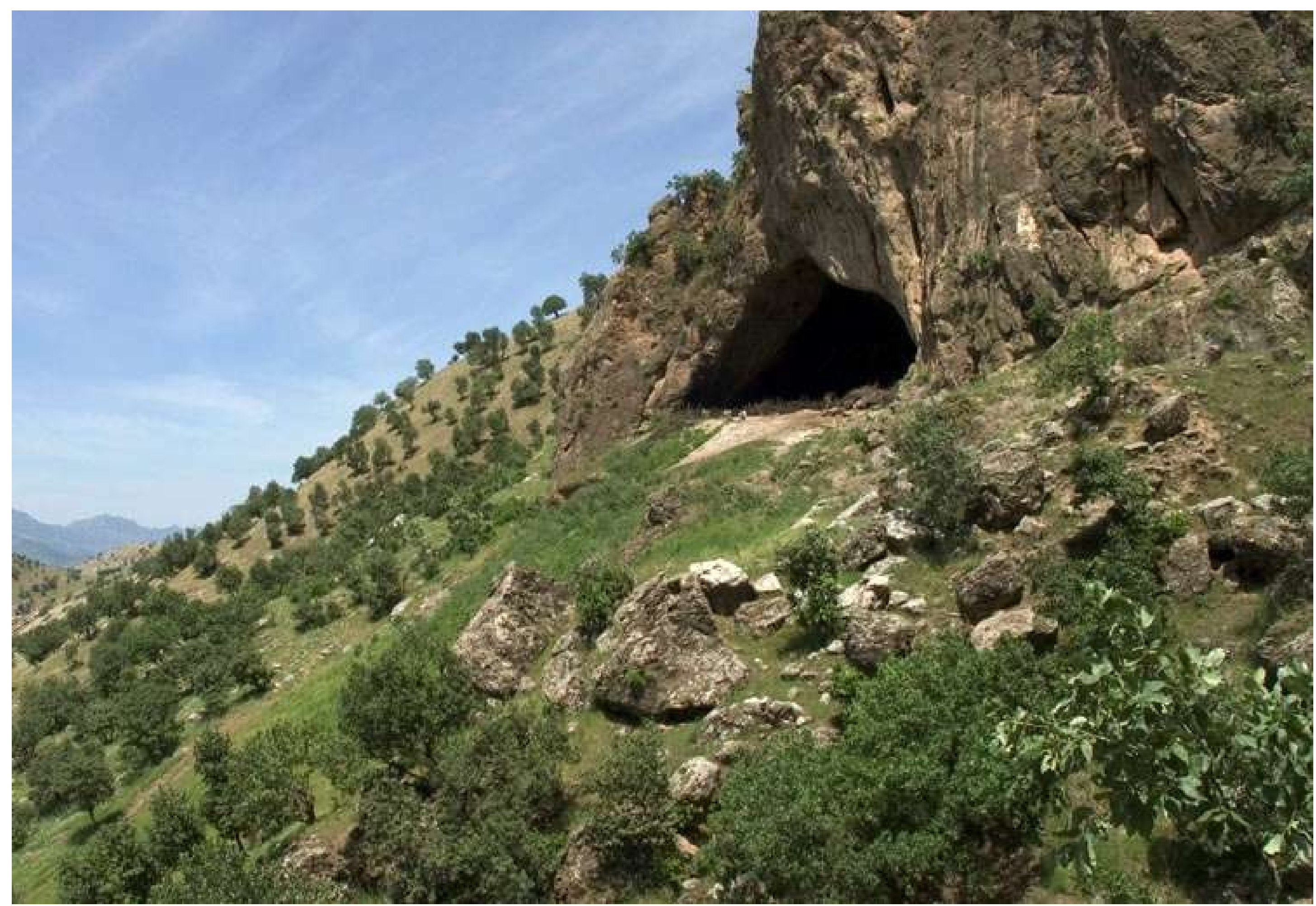
Focus on Iran: Greater Iran con



sisted of the area from the Euphrates in the west to the Indus River in the east and from the Caucasus, Caspian Sea, and Ural Sea in the north to the Persian Gulf in the south. It included the modern nations of Iran, Azerbaijan, Afghanistan, part of Pakistan, Turkmenistan, Tajikistan, Uzbekistan, the eastern part of Turkey, and Iraq. Once a major empire of superpower proportions, Persia has been overrun frequently in later years and has had its territory altered throughout centuries. Invaded and occupied by the Arabs, Turks, Mongols, British and Russians, Iran now occupies only a small part of its previous territories.

There are records of numerous ancient civilizations on the Iranian plateau before the arrival of Iranian tribes from Central Asia during the Early Iron Age. The earliest archaeological artifacts in Iran were found in the Kashafrud and Ganj Par sites that series of mountain ranges appear to Pakistan from this territory but these date back to Lower Paleolithic. There are also cultural remains of Neanderthal man dating back to the Middle Paleolithic period, which mainly have been found in the Zagros region and fewer in central Iran at sites such as Shanidar, Kobeh, Kunji, Bisetun, Tamtama, Warwasi, Palegawra, and Yafteh Cave. Evidence for Upper Paleolithic and Epipaleolithic periods are known mainly from the Zagros region in the caves of Kermanshah and Khoramabad.

In the 6th millennium BC the world developed a fairly sophisticated agricultural society and proto-urban population centers. The south-western part of Iran was part of the Fertile Crescent where most of humanity’s first major crops were grown. 7000 year old jars of wine excavated in the Zagros Mountains (now on display at The University of Pennsylvania) and ruins of 7000 year old settlements such as Sialk are further testament to this. Beyond these general remarks we do not know much about the Stone Age of Iran. Paleolithic research in this part of the world has been intermittent.



The cave site of Shanidar is located in the Zagros Mountains of Kurdistan. It yielded the first adult Neanderthal skeletons in Greater Iran.

Iran's geography consists of a plateau surrounded by mountains and divided into drainage basins. Dasht-e-Lut is one of the largest of these desert basins, and is considered to be one of the driest places on Earth. The eastern part of Dasht-eLut is a low plateau covered with salt flats. In contrast, the center has been sculpted by the wind into a series of parallel ridges and furrows, reaching 75 meters in height. This area is also riddled with ravines and sinkholes. The southeast is a vast expanse of sand, like a Saharan erg, with dunes 300 meters high, among the tallest in the world. It is a desolate place, without water and without life. Although the area has seen a brief period of civilization in the Bronze Age, ca. 3rd millennium BC, the borderline area, deep into both side of the Pak-Iran border, has been dry and inhabitable throughout the Holocene as well as in Pleistocene era.

Another major desert is the Dasht-e-Kavir The two deserts must have had an inordinate influence on the movement of early inhabitants of this region. The Dasht-e-Kavir occupies the north central region of present day Iran while to the east the Dash-e-Lut extends north to south. The breadth of these two deserts encompasses a majority of the central Iranian plateau and its uninhabitable conditions may have led to the preferential settlement of populations to the surrounding areas and their virtual isolation from those of Sindh and Baluchistan. Their portrayal as geographical barriers to gene flow has been supported by the Y-chromosome distribution of the M198 lineage (48,44,47,54) which seems to have skirted around this huge area while moving northeastward. A similar situation exists between India and Pakistan where the Thar Desert played even a bigger role in the inhibition of gene flow between Pakistan and central India. Where these physical boundaries were weak (e.g., between Sindh and Gujarat), however, one sees considerable Indian influence on the genetic make-up of Pakistani

population and vice versa. Several mtDNA and Y chromosome studies have been undertaken in the past two decades to assess the efficacy of gene flow between southern Iran and Baluchistan but with varying degree of success. All in all, this vast geographic impediment has prevented any large scale human migration between inland Iran and Baluchistan. If there was any movement of people between Iran and Pakistan, it was largely through southern Afghanistan and along the common coastline. Such an interaction, in fact, does exists, as will be shown in the next chapter, although on a small scale and only under favorable conditions.



A view of Dash-e-Lut (Iran) across Baluchistan

Genetic Studies: Genetically, Central Asia and Iran is one of the least-studied major regions of the world. Only a few systematic studies have been done and they too in very recent years. Genetic research in the region, although somewhat intractable, is, however, not completely absent. The early analysis of classical genetic markers in Central Asia has been done mainly by Soviet scholars, these classical genetic data demonstrated an intermediate position of Central Asians between the Middle East and East Asia. The global revision of data by Cavalli-Sforza et al. (19) was probably the first bold attempt in putting some order in the genetics of this region, but it added little to the idea that Central Asia is intermediate between Asia and the Middle East.

Some valuable work in molecular genetics has been done in recent years (43,44,47,48,49,50,51) and the data so collected have helped to define the main genetic features of the populations of this region. A few mtDNA studies have been conducted in the western and eastern extremities of this region. Some populations of the region have also been analyzed for Y-chromosome variation, in conjunction with the Iranian (47), Pakistani (48) and Central Asian populations (44,49,50). Comas and coworkers (43) sequenced mtDNA hypervariable region in samples of the Uighurs, the Kazakhs, and the Kirghiz, three ethnic groups of Central Asia, in order to investigate the origins and evolution of central Asian populations and to address several hypotheses concerning the population history of Eurasia. In a later study (51) Comas and coworkers studied sequenced Mitochondrial DNA (mtDNA) lineages of 232 individuals from 12 Central Asian populations for both control region hypervariable segments, and determined additional informative

sites in the coding region. This allowed them a more complete description of the mtDNA diversity in Central Asia, and its interpretation in relation to human origins and dispersals into and out of Central Asia. These data also made possible for them to test several scenarios concerning the spread of western peoples in Asia and their interaction with eastern peoples.

We also have at our disposal a collection of landmark studies by Quintana-Murci and associates to which we shall make frequent reference. There are, of course, some other researchers to whom we are indebted for equally significant investigations. We shall review a few of these studies in the followings.

Admixture of Already Differentiated Populations: It is known that the region was originally populated during the lower Paleolithic, and there is ample evidence of human presence in this area during the middle Paleolithic, including TeshikTash, the easternmost site from which Neanderthal remains have been recovered. It is not clear, however, whether the region was part of a "maturation" phase of anatomically modern humans, a throughway in the initial colonization of Europe and eastern Asia, or a place where Asian and European groups met after their respective expansions (42). The advent of the Neolithic seems to have been a local development without significant external population inputs. The domestication of the horse in the steppes and, subsequently, the development of wheeled vehicles had a major impact on world history, as mobility increased dramatically and warfare was profoundly changed. The interaction of these peoples with those of Early Indus period in Baluchistan is well documented and some colonies of the Indus people near mineral resources, such as Shortage in northern Afghanistan, have been excavated.

Most studies, based on classical markers, mitochondrial DNA (mtDNA) (98-101) or the nonrecombining portion of the Y-chromosome (102) have shown that genetic diversity in Central Asia is among the highest in Eurasia. Y chromosome studies suggest an early settlement of Central Asia by modern humans, followed by subsequent colonization waves in Eurasia, whereas some mtDNA studies point to an admixed origin from previously differentiated Eastern and Western Eurasian populations (99,51). This has been shown by several studies have shown that mtDNA pool of Central Asia is the result of admixture from east and west Eurasia (51) and have pointed to a major demarcation in the Eurasian landscape between European and East Asian mtDNA lineages within both the R and N branches. Major mtDNA haplogroup present in Central Asia are R, U, and M with their several subclade each. There is also a sprinkle of some other haplogroups, generally belonging to the lineage N. The presence of a high proportion of sequences originating elsewhere suggests that Central Asian populations have experienced intense gene flow and that this intermixing humans has been of relatively recent origin.

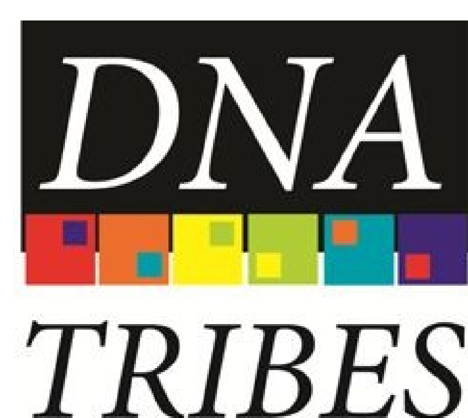
Genetic distances and their representation by principal-coordinate analysis point to Mongols and/or Chinese as the possible source of East Asian sequences in Central Asia. The Silk Road crossed the region, and it could have channeled migration along the east-west axis of Eurasia. Both the fact that an extinct Indo-European language, Tocharian, was spoken in the area during the latter half of the 1st millennium A.D. and the recent discovery of mummified bodies with European facial traits point to the presence of Western peoples in Central Asia into which Eastern elements were later infused. Thus, although it is not possible to pinpoint the process that generated the Central Asian peoples, it is clear that the different gene pools that merged in their formation had already diverged in the outer reaches of the Eurasian continent (51).

The presence of western and eastern sequences found in Central Asia leaves open questions about the mode and tempo of the generation of this admixture of lineages. Two scenarios could have produced this mtDNA pattern in Central Asia: (a) Western peoples inhabited Central Asia and were partially replaced by Eastern peoples, Central Asia being a hybrid zone. (b) Central Asia has been a ‘contact zone’ between two differentiated groups of peoples who originated in east and west Eurasia, respectively. There is no solid reason for advocating one scenario over the other and consequently the dynamics of the process that generated the mixture

!

Genetic Footprints of the Indus Man!"#$%&'()*

of eastern Asian and European mtDNA sequences clear from this figure that Pakistani populations in Central Asia is still not clear. In fact, the same
end result could have been achieved whether gene
flow occurred from the East or the West or by a
combination of both processes. Recent data of Y!
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shown that genetic diversity is heterogeneous in the

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In their most recent study Quitana-Murci region, with some high-diversity populations con

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and his associates (94) confirm the results of earlier

trasting with much reduced levels in others. This &(93!'J(!>359&!$(&'(3)!9&:!'39:

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tral Asian populations, and to

&(4IJ5%34&I! 93(9)! O)>$J! 9)! 'J(! W&:>)! X9##(;! 9&:! 1%3'J! W&:49! 3(I4%&)R! 'J3%>IJ! $>#'>39#! :4??>)4%&! 9&:Z%3!)($%&:93;!#%$9#!@4I39'4%&)!V4'J4&!")496!

westward expansions of eastern nomadic groups during

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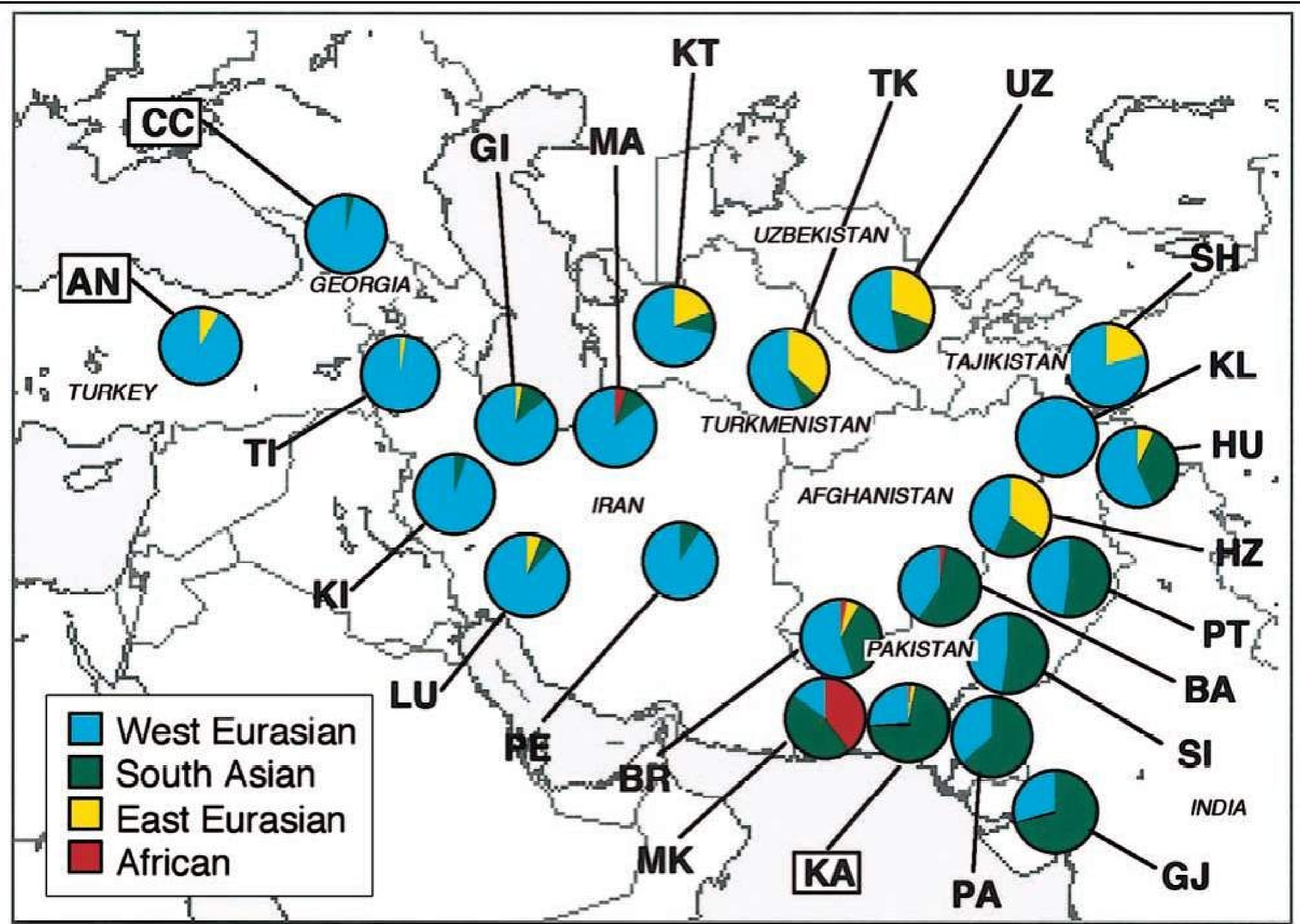
9&:! 1%3'J! W&:49! OP6HQR! 3(I4%&)F! 5>'! 4)!&%'! ?%>&:!
4&!'J(!C(3)49&!9&:!S9#%$J4!3(I4%&)6!2J4)!)>II()')!'J(! landscape. They confirmed S9#'4$.A39#)!$%@8%&(&'!@4IJ'!&%'!J9<(!5((&!4&<%#
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that, as a general rule, the

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people inhabiting the area are

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tween differentiated popula'J(! N()%#4'J4$! 8(34%:! 9&:! 83(.:9'(! 'J(! #9'(3! W&:%.M>3%8(9&! (=89&)4%&)6tions, which has produced a
h i g h g e n e t i c d i v e r s i t y $%@8%&(&'! @4IJ'! 9#)%! J9<(! 5((&! ?>3'J(3! '39&)@4''(:!5;!W&:%.M>3%8(9&!)8(9T4&I!8%8>#9'4%&)!9$'4<(!4&! U(&'39#!")49!9&:!B45(349!:>34&I!#9'(3!8(34%:)!O8%))45#;!4&$#>:4&I!S3%&\(!"I(!"&:3%&%<%!9&:!W3%&!"I(! B9T9!$>#'>3()R6
/,!! pology has also defined Cen

tral Asian populations as pre

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senting an admixture of east

Figure 1. Map of the southwestern and Central Asian corridor, showing the samples4&$#>:()! 8%8>#9'4%&)! &(93! 'J(! 2934@! S9)4&F! VJ(3(! 'J(! >&>)>9#! 2%$J9349&! #9&I>9I()! V(3(!)8%T(&6! 2J4)!

analyzed in the present study. Population codes are as reported in table 1. Boxed popupometric traits.

1%3'JV()'!M>3%8(9&!$%@8%&(&'!4)!&%'!? %>&:!4&!'J(!%'J(3!)'>:4(:!3(I4%&)!%?!")49!O(=$(8'!?%3!9!'39$(!,6-Q!Quintana-Murcilations are those used for the initial step of the study (see the “Materials And Methods” 8(3$(&'9I(!4&!'J(!C(3)49&!3(I4%&R6!2J4)!)>II()')!'J(!1%3'JV()'!M>3%8(9&!$%@(&'!V9)!&%'!4&<%#<(:!4&!section). Pie charts show the distribution of the main mtDNA lineage groups in the

genetic variation further re

populations studied. Colored sections reflect the frequency of different haplogroup clusI(&(39#! W&:%.M>3%8(9&! (=89&)4%&)! 4&! ")49F! 9&:! 4&)'(9:! 3(9$J(:! L()'! B45(349! ")49! 'J3%>IJ! 9!)(8939'(!

ters, which group the western Eurasian the South Asian the eastern Eura Maps of First veals that Central Asian di

(top), Second (middle), and Third (bottom)Principal Components (Cavalli-Sforza)M>39)49&!B'(88(!@4I39'4%&!O)>$J!9)!'J(!(93#;!"?9&9)(<%! (=89&)4%&!'%!B45(349R6!!

!

An important genetic study is that of !"# $%&'() "(*+, -./0.1/1 2.1+ 3%4'+%**.)%.) 5.6+'0 7*.61 " (*+,8%1+Quita-Murci and associates (53). They inves
tigated the mtDNA of 23 population groups,!"#$%&' ()*+, (-*., -*-,listed in Table 1, from a broad area of South
west Asia, including Iran, central Asia, and 2&3456% .+*7, ++*-, -*-,Pakistan. This area they designate as 9':;$ <&33"= (0*.,)*.,)*),Southwest and Central Asian Corridor.
Figure 1 depicts the the distribution >4#?6 9':%& +7*(, (*-, (*-,of the main mtDNA lineage groups in the
populations studied. The haplogroup reper@"$? A%B"#%&' 71*7, 7*., 77*(,toire presented in this study confirms
whatversity is mainly shaped by linguistic affiliation, with
has been said above, that is, the genetic composi**%5(6)$78**!L()'!M>39)49&!OM>3%8(9&!9&:!M9)'!N(:4'(339&
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Iranian populations largely
Turkic-speaking populations forming a cluster more
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consists of the ‘western’ haplogroups with an ad
closely related to East-Asian populations and Indo

!!!Iranian speakers forming a cluster closer to Westmixing of the ‘eastern’ component that varies from [ern Eurasians. The scattered position of Uzbeks region to region, showing a decreasing gradient!_%3!@%3(!4&?%3@9'4%&F!)
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toward the west. The figure is revealing about the
/,
across Turkic- and Indo-Iranian-speaking popula
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M9)'(3&!M>3%8(R6!B((!M6!M6!a>\@4&9F!2J(!C3(J4)'%3;!%?!'J(!B4#T!b%9:6!!
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B%>'J!W&:49F!245('9&F!9&:!L()'!"?34$9&!I(&('4$!$%@8%&(&')!%?!'J(!)'>:4(:!3(I4%&)6!
Table I. Description of populations included in the study

Table 1

Description of the Populations Included in the Study

Population	Code	n	Location	Language Family
Turkish[a]	AN	50	Anatolia, Turkey	Altaic
Caucasus[a]	CC	58	Georgia	Caucasian (north/south)
Persian	PE	42	Central and southern central Iran	Indo-European
Turkish	TI	40	Mostly eastern and western Azerbaijan	Altaic
Gilaki	GI	37	Northern Iran, southwestern Caspian Sea area	Indo-European
Mazandarian	MA	21	Northern Iran, southeastern Caspian Sea area	Indo-European
Kurdish	KI	20	Western Iran	Indo-European
Lur	LU	17	Southwestern Iran (Zagros Mountains)	Indo-European
Baluch	BA	39	Southwestern Pakistan, Baluchistan	Indo-European
Brahui	BR	38	Southwestern Pakistan, Baluchistan	Dravidian
Parsi	PA	44	Southeastern Pakistan, Karachi	Indo-European
Sindhi	SI	23	Southeastern Pakistan, Sindh	Indo-European
Pakistani[a]	KA	100	Karachi, Southeastern Pakistan	Indo-European
Pathan	PT	44	North West Frontier Province and Balochistan	Indo-European
Makrani	MK	33	South Pakistan, Makran Coast	Indo-European
Hazara	HZ	23	North West Frontier Province and Balochistan	Indo-European
Hunza Burusho	HU	44	Northern Pakistan, Karakorum Mountains	Language isolate
Kalash	KL	44	North West Frontier Province	Indo-European
Gujarati	GJ	34	Northwestern India, Gujarat	Indo-European
Uzbek	UZ	42	Surkhandarya, Uzbekistan	Altaic
Turkmen	TK	41	Turkmenistan	Altaic
Kurdish	KT	32	Turkmenistan	Indo-European
Shugnan	SH	44	High Pamirs, Tajikistan	Indo-European

[a] These samples consist of mixed groups (see the "Materials and Methods" section for a detailed description) that were used in the initial step of the study.

groups and subhaplogroups within the mtDNA phylogeny. These markers were then selectively assayed, on the basis of the HVS-I information, in the remaining 702 mtDNAs by PCR amplification of the appropriate fragment and digestion with the informative restriction enzyme.

Data Analysis

guistic affiliation: Indo-Europeans (Persians, Lurs, Iranian Kurds, Mazandarans, Gilaks, Baluchi, Parsi, Sindhi, Pakistani-Karachi, Pathans, Makrani, Hazara, Shugnan, Kalash, and Gujarat), Altaic (Anatolian, Iranian Turks, Turkmen, and Uzbek), Dravidian (Brahui), Caucasian (Caucasus), and language isolates (Burusho). The population genetic structure was also explored through the spatial analysis of molecular variance (SAMOVA) approach (Dupanloup et al. 2002), which defines groups

(94) propose that the complex genetic landscape of Central Asian populations results from the movements of eastern, Turkic-speaking groups during historical times, into a long-lasting group of settled populations, which may be represented nowadays by Tajiks and Turkmen. Contrary to what is generally thought, their results suggest that the recurrent expansions of eastern nomadic groups did not result in the complete replacement of local populations, but rather into partial admixture.

Table2,derivedfrom Quintana-Murci's recent report (94) summarizes the the proportion of the 'western' components (North caucasus and Mediterranean) in Persian, Baluchi, Indus Valley, and North Indian populations. The table clearly shows sharply decreasing 'western' elements as we move from west to east.
Again, Pakistan seems to be the last frontier with a significant proportion of the western component. Figure 2 presents the same data in pictorial form.

Among other findings, Quantana-Murci team confirmed the results of Li *et al*'s study (103) that cluster the Hazara population with Central Asian populations, rather than Mongolian populations hithertofore claimed. This is consistent with ethnological studies (104). Quintana-Murci's results (94) further extend these findings by showing that

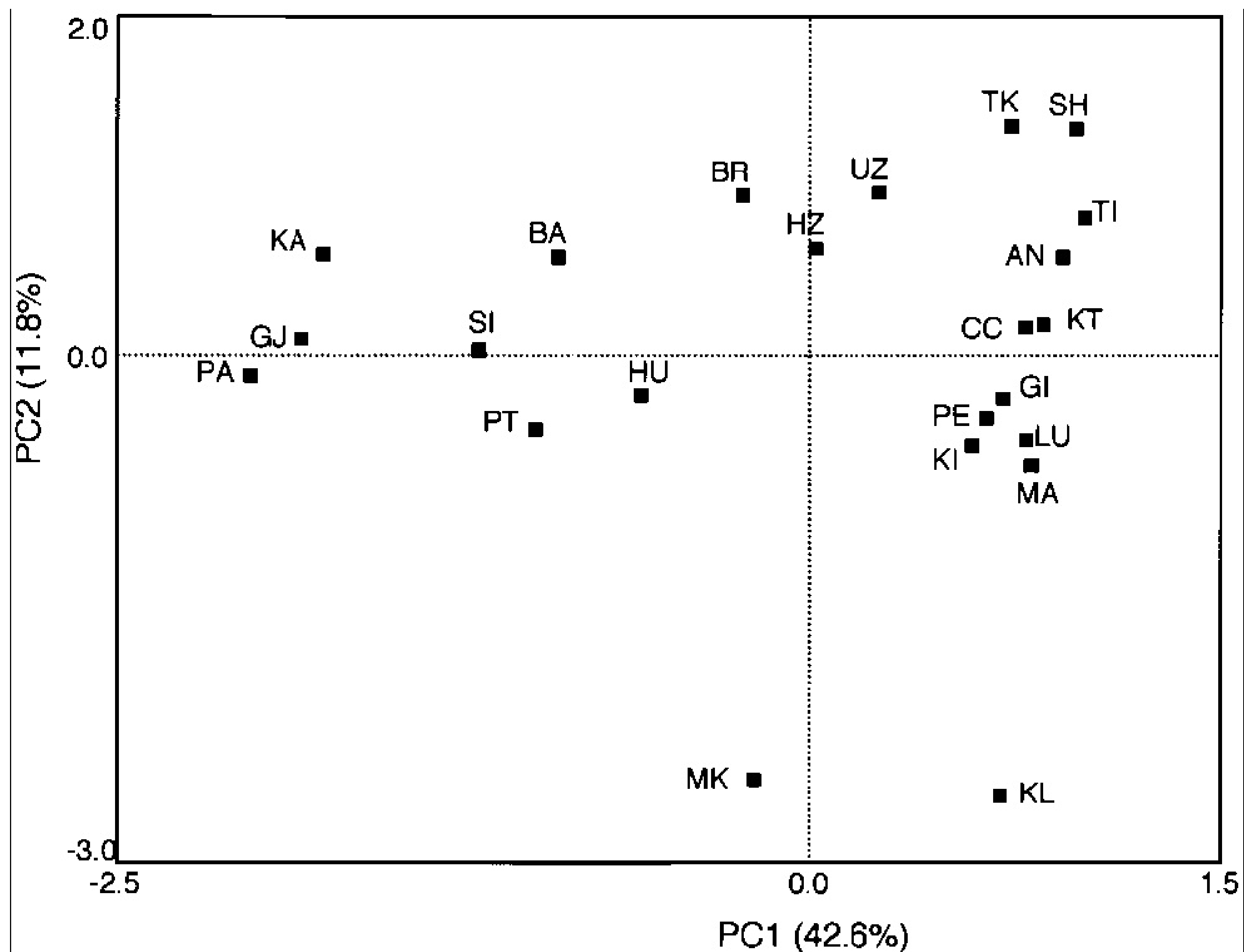


Fig.3. PC plot based on haplogroup frequencies for 23 population samples described in Table 1. (48)

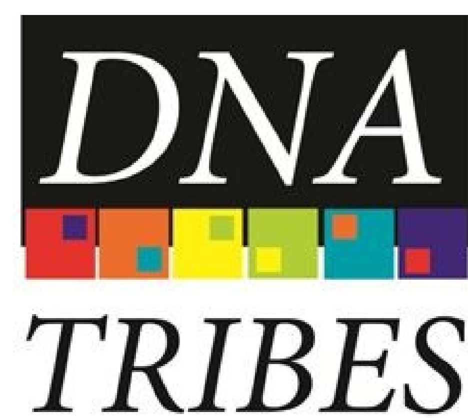
the Hazaras are closer to Turkic-speaking populations from Central Asia than to East-Asian or IndoIranian populations

In a previous study Quintana-Murci et al (48) used the basal mtDNA haplogroup frequencies of different groups as input vectors to perform a PC analysis. They showed that a simple pattern underlies the mtDNA variation in this region: a west-toeast divide with a sharp boundary. Populations located west of the Indus basin, including those from Iran, Anatolia and the Caucasus, exhibit a common mtDNA lineage composition, consisting mainly of western Eurasian lineages whereas there is a virtual absence of common Indian lineages in these populations. Whatever influence there is, it appear to be restricted to the eastern part of Iran. This set of data, combined with several from Indian populations shows that Pakistan effectively separates the genetic values of Indian populations from those of the west and the genetic composition of Pakistani populations itself is a complex admixture of the east and the west. Pakistani populations west of the Indus mostly exhibit a rich variety of west Eurasian lineages at high frequencies (26%–57%), with a

sult from later admixture between western and in frequencies only between 1 and 10 per cent

!"#$%&'()*
in
rapidly decreasing gradient towards India, ranging **+$!',)*-$"./)0()&$12$3413$** eastern Eurasian populations.

India. While the gene flow from the Indus Valley to $ The proportion of western Eurasian
linea "##!$%&'(&')!*!+,,-.+,/+!01"!2345()6!!01"!2345()76!
southern Iran is limited, that from the West to Paki 01"!2345()!89'(&'(:!9&9#;)4)!4)!9<94#95#(!(=$#>)4<(#;!?
3%@! ges (HV, pre- HV, N1, J-T, U-K, I, W, and X) showed



stan has been more common. This directional dis 01"!2345()6!A6B6!C"26!1D6!EF+EGFHE-6!"##!34IJ')!3()(3<(:6 the opposite pattern of that exhibited by Indian

! parity in gene flow could only be explained by a
!"#$%&'()*+*$,-$./*0$123'*+'&$4,56,&/&0*$+&$%*+'$$
general west-to-east direction of human dispersal or

! that of a diffusional wavefront.
specific lineages. They exhibit their highest frequencies in the Anatolian/Caucasus and Iranian regions and their prevalence decreases eastwards. to the antiquity of Iranian and central Asian populations.

The eastern Eurasian (the so-caled Oriental component) contribution to the west is negligible in Iran and Pakistan. This pattern may seem surprising in view of the historically documented repeated waves of Mongol invaders throughout the region. Ychromosome data from Central Asia, show that the Central Asians exhibit high frequencies of ‘oriiental’ lineages, which are otherwise virtually absent in populations of Pakistan, Iran, and India. Two explanations have been put forward: Central Asians could represent an early incubator of Eurasian variation, or their current genetic diversity could re

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Deep Rooted Lineages: As stated in the Despite this decreasing frequency cline towards the
Q&:>)! R9##(;F! 1%3'J! Q&:49F! 9&:! K()'! B45(349&! 3(I4%&)! S(3(! 4:(&'4?4(:! >)4&I! 9>'%)%@9#! B1C! :9'9!
last chapter, the macrohaplogroupand M and its ˉ East, they are still present at relatively high fre M(=$#>:4&I!#%$9#!9:@4='>3(!?%3!'J()(!#4)'(:!3(I4%&)O6
!!T()>#')!93(!)>@@934U(:!4&!**%5(6)$7**!9&:!4##>)'39'(:!4&**$** quencies in the Indus Valley

and Central Asia. Indeed, the western Eurasian presence in the Kalash population reaches a frequency of 100%, the most prevalent haplogroups being U4, (pre-HV)1, U2e, and J2. A careful look at these haplogroup suggest that several of them are either autochthonous to the southwestern Asian corridor or that at least they underwent a major expansion in this region. Among these lineages, haplogroup U7 presents the most widespread distribution. This haplogroup is present in most of the populations

I(&('4$! $%@8%&(&')! %?! 'J(!)'>:4(:! C(3)49&F! P9#%$J4F! Q&:>)! R9##(;F! 1%3'J! Q&:49
linking the Near East with Central and South Asia,

$
**8',9&)$7**V!K()'!L>39)49&!ML>3%8(9&!9&:!L9)'!N(:4'(339&(9&O!B1C!$%@8%&(&')!4&!'J(!C(3)49&F!P9#%$J4F!Q&:>)!R9##(;F!
1%3'J!Q&:49F!9&:!K()'!B45(349&!3(I4%&)6!C(3$(&'9I()!?3%@!%>')4:(!%?!K()'!L>39)49**Figure 2. West Eurasian (European and East Mediterranean) SNP components in the**

$ Persian, Balochi, Indus Valley, North India, and West Siberian regions. Percentages from !'*:9'.;**<!T()>#')!4&!**outside of West Eurasia are listed as"Other. (94)** EF! 9&:! K()'! B45(349&!
3(I4%&)6! Q&:%.L>3%8(9&! #9&I>9I()!
J9<(!5((&!)8%Z(&!4&!9##!%?!'J(!)'>:4(:!3(I4%&)!834%3!'%!'J(!@%:(3&!

8(34%:!M)((! **8',9&)1**4&!'J(![4)'%34$9#!P9$ZI3%>&:O6!! of south!\%3!9##!)'>:4(:!3(I4%&)F!'J(!#93I()'!K()'!L>39)49&!I(&('4$!$%@8%&(&'!4)!1%3'J!]9>$9)>)6!2J4)!4)! reaching its highest fresubclades represent the remotest link quencies in some Iranian and Indus Valley populaAsian populations to their African origin.

TheJ4IJ()'!4&!'J(!P9#%$J4!3(I4%&!MH+6/^OF!SJ4$J!S9)!'J(!)4'(!%?!(93#;!9I34$>#'>39#!$%@@>&4'4()!%?!N(J3I93J!

9&:! #9'(3! S9)! 95)%35(:! 4&! 'J(! P3%&U(! "I(! [939889&!]4<4#4U9'4%&6! 1%3'J!]9>$9)>)! $%@8%&(&')! 93(! 9#)%!tions, in agreement with recent data reporting a fre

Quintana-Murci's data show (48) that the South quency of 9% in a composite Iranian sample. The?%>&:! 9'!)4@4#93! #(<(#)! 4&! 'J(! C(3)49&! M_E6+^O! 9&:! Q&:>)! R9##(;! M_W6H^O! 3(I4%&)6! B>5)'9&'49#! 1%3'J!

Asian influence, as represented by the nodal type of]9>$9)>)!$%@8%&(&')!93(!9#)%!4:(&'4?4(:!?%3!'J(!1%3'J!Q&:49!M+/6_^O!9&:!K()'!B45(349&!M/G6/^O!3(I4%&)6!overall coalescence time calculated for U7 is 38,200macrohaplogroup M (M*), is virtually absent or in+/-13,900 years and is a clear indicative of the deep!!

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!\%3!@%3(!4&?%3@9'4%&!95%>'!01"!2345()7

frequent in all the populations west of the Indus Valroots of the Iranian populations, although not as ley and is present at low frequencies in Central!B1C!9&9#;)4)F!)((! J"8V``:&9'345()6$%@`)&86J'@#

W! C(3$(&'9I()! #4)'(:! >&:(3! XD'J(3Y! 4&$#>:(:! "39549&F! "3$'4$F! L9)'! ")49&F! L9)'! B45(349&F! LI;8'49&F! N()%9@(34$9&F!

Asian populations (12%). Conversely, it is present deep as those of haplogroup M and its sub-lineages B%>'J!Q&:49F!245('9&F!9&:!K()'!"?34$9&!I(&('4$!$%@8%&(&')!%?!'J(!)'>:4(:!3(I4%&)6! which are prevalent in India and eastern part ofat high frequencies (30%–50%) in populations living!2J(!X1%3'J!Q&:49Y!B2T!3(I4%&!:4??(3)!?3%@!'J(!X1%3'J!Q&:49Y!B1C!3(I4%&V!'J(!B1C!3(I4%&!4)!)8($4?4$!'%!&%3'J(3&!

Pakistan.

in the southern coasts of Pakistan and the north893')! %?! Q&:49! 9&:! 3(#9'(:! P39J@4&! 8%8>#9'4%&)! 'J3%>IJ%>'! Q&:49a! 4&! $%&'39)'F! 'J(! @%3(! 4&$#>)4<(! B2T! 3(I4%&!

(&$%@89))()!8%8>#9'4%&)!%?!'J(!XP9#%$J4YF!XQ&:>)!R9##(;FY!9&:!X1%3'J!Q&:49Y!B1C!3(I4%&)6!! **Recent Movements of Populations:** Ani

eastern area of Punjab (see Figure 1.). Thus, the$ mal domestication, particularly the horse, gave thestudy of M subclades does not give us any lead as

!"#$%&'()*+$!',)*-$"./)0()&$12$3413$ $ C9I(!-!%?!/+$inhabitants of the Central Asian steppes the oppor!

***!"#$%&&&'()*+,-#"./012%***"#$%&'!()$*()$+,%-./012#3!4$1.-225'!6$1.-225012#789:+,%-./!tunity to expand geographically in different direc

;$%&'!89:!<,%-./=!>0?0!@2A!BCD=!:,&%)E+2)=!F:!GGGHI!

Conclusions?

tions (38). These central Asian nomads, probably from the Andronovo cultures, migrated through Afghanistan and Iran, reaching Pakistan at the early juncture of the decline of the Indus Civilization, *ca*. 2000 years ago. Their arrival on the Iranian plateau brought the Indo-Iranian branch of the IndoEuropean language family and, eventually, caused the replacement of Dravidian languages in Iran, Pakistan, and most of northern India (39,40,41). The eastern part of the Eurasian steppes also witnessed similar pastoral movements. By the time of the 3rd century A.D., Turkic-speaking peoples from the Altai region began to migrate westwards, replacing Indo-European languages in parts of Central Asia and, eventually, in what is now modern Turkey. Later, the Mongols also moved westward and, by the 13th century A.D., established their rule over a vast region, including a large part of Pakistan and Iran and reaching as far west as the Caucasus and Turkey.

The evidence of these historic migrations from central Asia to Afghanistan and Pakistan is pretty robust but we lack much of an evidence, archaeological or genetic, that could offer us a clue to the migration of earlier humans into Central Asia or from Central Asia to Iran and Pakistan. Similarly, the answer to the question of the presence of the socalled 'Mongoloid' genes in Central Asia and their spread southward is shrouded in mystery. Nevertheless, we do have some indications of these genetic linkages whose legacy we still can trace in the present day populations of this region and from this we can, at least in some cases, get some idea about the dispersal of humans in Pakistan.

This brings us to the thorny subject of the "Aryan Migration" to the Indus Valley. Since in this chapter our primary interest lies in the genetic interactions of the Greater Indus Valley within preHolocene period, i.e. in the Stone Age, we need not get ecited with the prospect of a lively debate about this red herring of South Asian prehistory. Suffice here to say that any migration or invasion, if it really did happen, must be of substantial strength as to have any genetic signature on the current population. There were several small scale migrations of pastoral nomads in Pakistan's history but none of

them have left any trace in the genetics of the current population.
Conclusion: Pakistan is the area where the West meets with the East. Thus, the study of population genetics of central Asia and Iran is important

in investigating the genetic mix of Pakistan's population. The population of this region is an admixture of western (i.e., the Near East and European) and eastern (i.e. the so-called Mongoloid)

stocks, with a minor component of South Asian origins (i.e. Indian). The western component probably originated in the Near East and the eastern component most likely came through the population expansion from Mongolia or China.

In terms of genetic signature of the past population movements, the Indus River seems to be a demarcation line between predominantly western influences and a mixture of western and South Asian contributions. Because of a continued infusion of genes into this area from several directions and over a long period of time, the study of population genetics in central Asia is a particularly difficult task. This especially applies when one attempts to isolate the deep rooted lineages from the more recent introductions. As a general rule, the deep rooted lineages in central Asia are not clearly discernible. Most of the lineages, whether western or eastern in origins, seem to be younger than those in Pakistan. This is probably for the repeated overwriting on the original signatures rather than a late colonization of this region.

IV.3. Genetic Imprint of the East



This chapter is a brief survey of the genetic landscape of India and an attempt to see how Indian-specific material influenced netic make up of the presentday populations of Pakistan and how the latter transmitted some of this genetic material to Iran and possibly to Central genetic

the ge

Asia. From historical perspective it is also pertinent to see how Pakistan transmitted some of the western genetic material to the adjoining populations, specifically to the people of Indian Punjab and Haryana on one hand and to those of Gujarat on the other hand. Was it a population expansion from the Indus Valley into Gujarat and the Ganga-Jamuna plains, or was it simply a case of static wave of genetic diffusion? Of equal consideration is the question of timing. Thus, the study of genetic landscape of India is very relevant to the study of the population history of Pakistan.

India is a land of great diversity in geographical features, topographical forms, and ethnic distribution. To the west of peninsular India is the Arabian Sea, to the East the Bay of Bengal, and to the south is the Indian Ocean. The north is dominated by the Greater and Lesser Himalayas and the Siwalik hills, all ranges almost parallel and temporally successive to each other. South of these mountain and hill ranges are the Ganga-Jamuna plains and to the southwest of these plains is the Thar Desert, which effectively divides the subcontinent between India and Pakistan. To the south of the Ganga-Jamuna plains are the Vindhyan range of hills. These hills are located north of the Deccan Plateau, a prominent landscape of peninsular India that includes the Western and Eastern Ghats (ranges of coastal hills). To the northeast are the hills of Assam where the kingdom of Bhutan also lies. Sri Lanka is an island off the southern tip of peninsular India but culturally and linguistically it is intimately connected with south India. During the Stone Age, it was physically connected with India landmass.

The spectrum of connected through a complex geological history. Although most parts of India are recognized as being tropical or sub-tropical, such landscapes are entire country comprises a diverse

ecological and topographical zones prominent only along the coast of peninsular India. The country is also interspersed with a large number of rivers and streams, and although agricultural land makes up over 60% of the area, numerous ecological and geographic features such as deciduous woodlands, tropical evergreen forests, savanna, semi-arid and arid scrub lands, arid sand deserts, and periglacial loessic landforms, caves, canyons, rock-shelters, lakes, pools, and springs are also found in large numbers. Excepting the rivers of Narmada and Tapi, most rivers in India flow from west to east and

exhibit unique fluviosedimentary regimes, which is quite different from that of the Indus system. Most importantly, however, India is well known for its prominent monsoon regime, which has been in existence since Miocene times and, no doubt, must have had major implications on the patterns of human evolution and behavior during the Pleistocene. These climatic conditions are, obviously, different from the area to its west, i.e., Pakistan, which is largely a dry zone, in fact the eastern end of the Great Saharan Desert.

Like Pakistan, India stands on the road the early humans inevitably must have taken to reach eastern Asia, New Guinea and Australia. Did some of the migrating waves of humans settle there instead of going *in corpore* further eastwards? Was it the place where the initial radiation of Eurasian mitochondrial DNA lineages took place? What is the age of these ancient lineages of modern humans in this region, and what do these ages tell us about the spread of modern humans in South Asia, including Pakistan? Above all, to what extent are the populations of Pakistan indebted to this land in its genetic make-up or vice versa? These questions are presently being actively researched and debated. Human genetics is thus acquired a special importance in this search.

Though archaeological evidence for the existence and activities of hominin populations is profuse throughout the Indian subcontinent during the Middle and Late Pleistocene, the fossil record of hominins during this period is quite poor. Only a partial hominin cranium (around 250,000–300,000 years old) has been found in the Narmada riverbed at Hathnora in Madhya Pradesh. This cranium is currently attributed to Homo *heidelbergensis*. The earliest fossils of modern humans in South Asia have been unearthed in Sri Lanka and are dated to around 28,000–34,000 years before present. This should be seen in context with the skeletal evidence in East Asia, which was previously considered not any older, an age of just 30,000 years ago, but recent research has extended its age to almost 60,000 years before present.

In the absence of any notable fossils record, the presence of early humans in India, in fact the whole of South Asia, is attested by a large array of stone tools which are found scattered around a large area, from the foothills of the Siwaliks to the plains of Madras. Another set of evidence is that of genetics and this forms the core of this chapter.

Genetic research is quite recent in India. A large number of projects have been undertaken with the explicit aim of proving (or disproving) the migration of the Indo-Aryans into the subcontinent and their contribution (or non-contribution) to the genetic make-up of the higher castes of India. Another matter of keen interest has been to seek a link between the ‘caste’ populations of India with the “Caucasus” populations of Europe. A third topic of immense curiosity has been the genetic differences between the ‘caste’ populations and the ‘tribals’. The interpretation of results have frequently fallen prey to religious zealotry and almost an incessant desire to serve the ‘national interest’. This undue emphasis on castes, ‘tribals’, Indo-Aryans, genetic unity, and ‘national interest’ on the part of some Indian scholars and lay intellectuals has severely distorted the research in archaeogenetic of the whole South Asia, including Pakistan. This is in face of the fact that several studies have shown that the genetic roots of Indian populations go deep into ancient times and that the legacy of recent migrations to India from the West or the East is rather minor, if at all. The question of the Aryans is marginal to us in context of the present discussion, our focus being on the Stone Age.

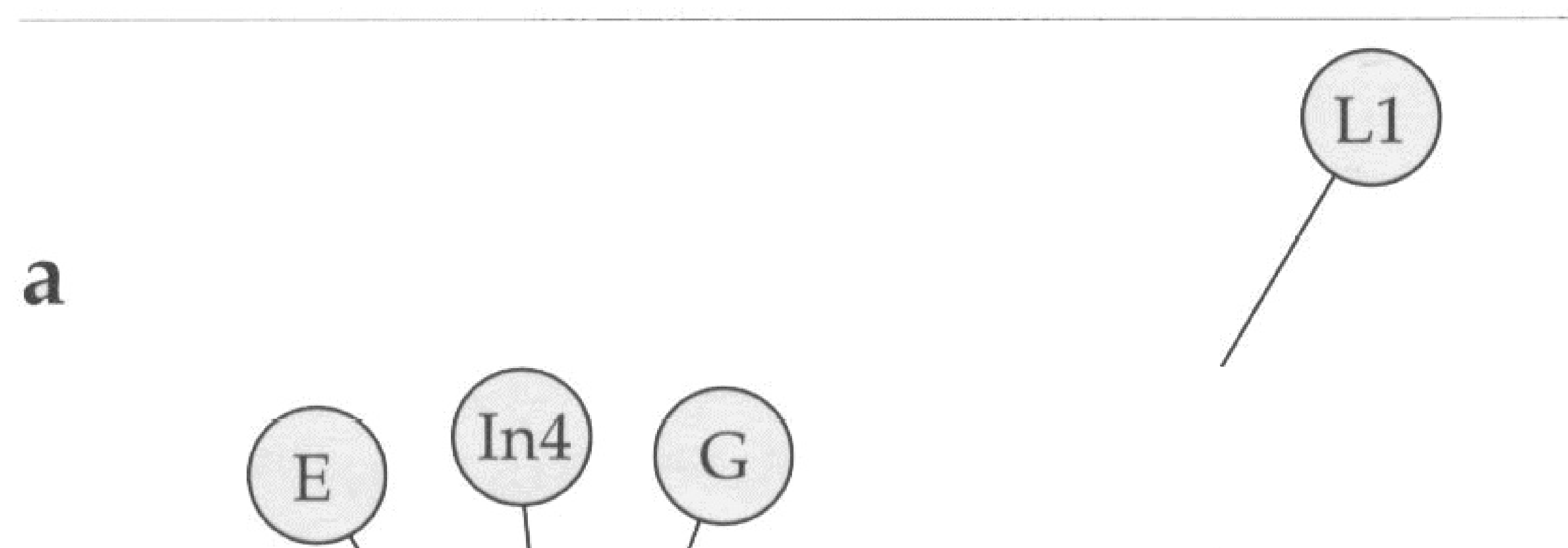
Another problem has been that most of the researchers, the Indian as well as the Western, talk about the Indian population as though it were one entity. We know very well that the populations of South

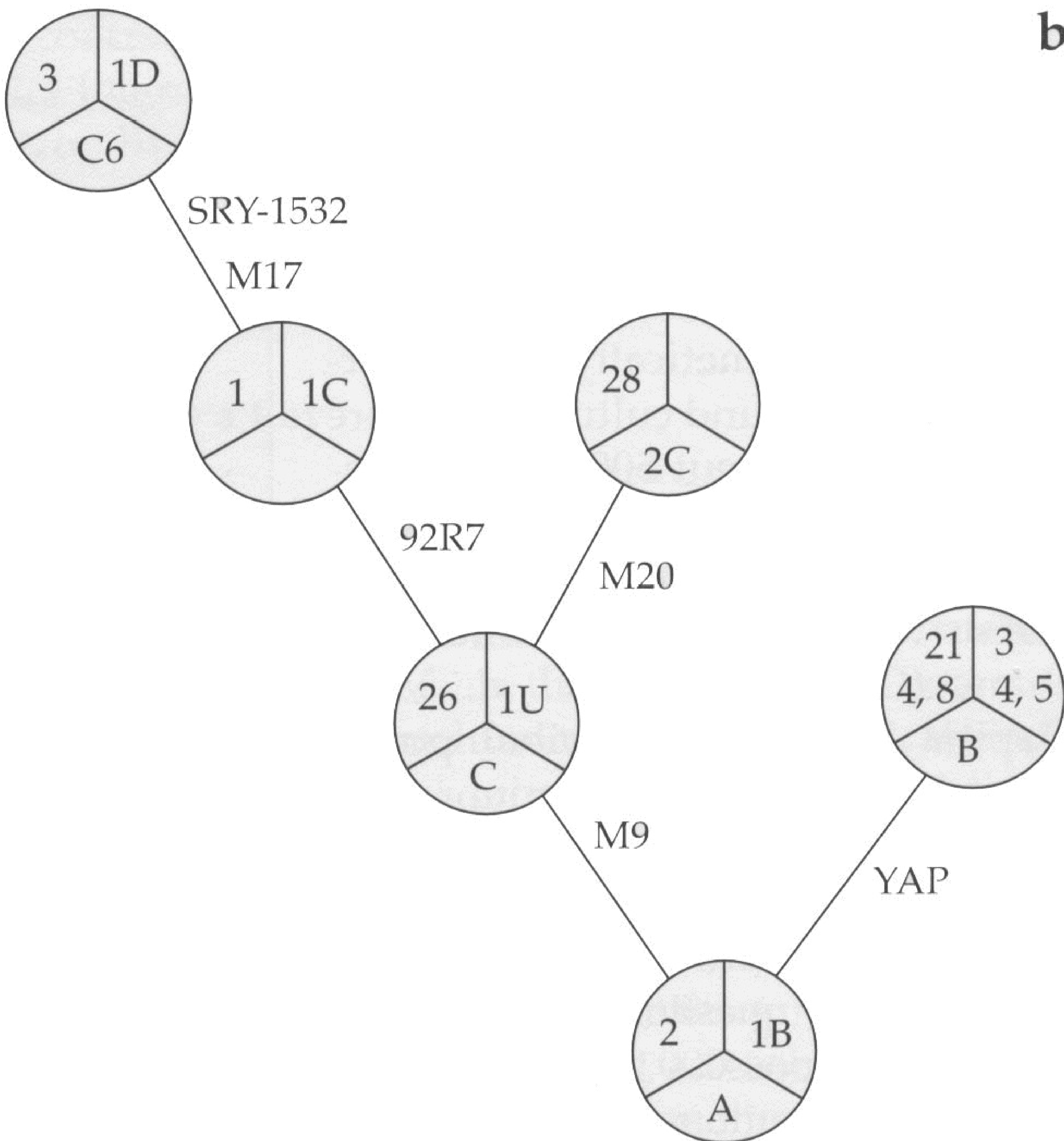
India are genetically very different from those of northern India and the populations of eastern India have in many respects very little relationship with those of western India. This “averaging out” of the genetic data has diminished the value of several excellent research projects, which could otherwise have yielded valuable information about the Stone Age populations of India and their interaction with each other.

Nevertheless, several in-depth studies have recently been reported that describe the ethnic landscape of India by pinpointing the genetic structure of a large number of populations and their relationship with each other and with those of the West and the East. These results have contributed to the understanding of the initial settlement of South Asia by modern humans in context with Eurasia at large. Differences in allele frequencies in and between different populations is becoming the major platform for studying the history and structure of Indian

257 populations and this work is expected to yield useful results.

Deep-rooted Lineages of the Indian Populations: The Indian subcontinent is currently populated by more than one billion people who belong to thousands of linguistic and ethnic groups. Genetic and anthropological studies have shown that the peopling of the subcontinent is characterized by a complex history, with contributions from different ancestral populations (65,97) and subsequent process of admixing with later newcomers. Our starting point is, naturally, with haplogroup L3, from which arose two mtDNA macro-haplogroups Toomas Kivisild *et al.*




b
3
1D
C6
SRY-1532
M17
1
1C
28
2C
92R7
M20
26
1U
C
21
4, 8
3
4, 5
B
M9
YAP
2
1B
A

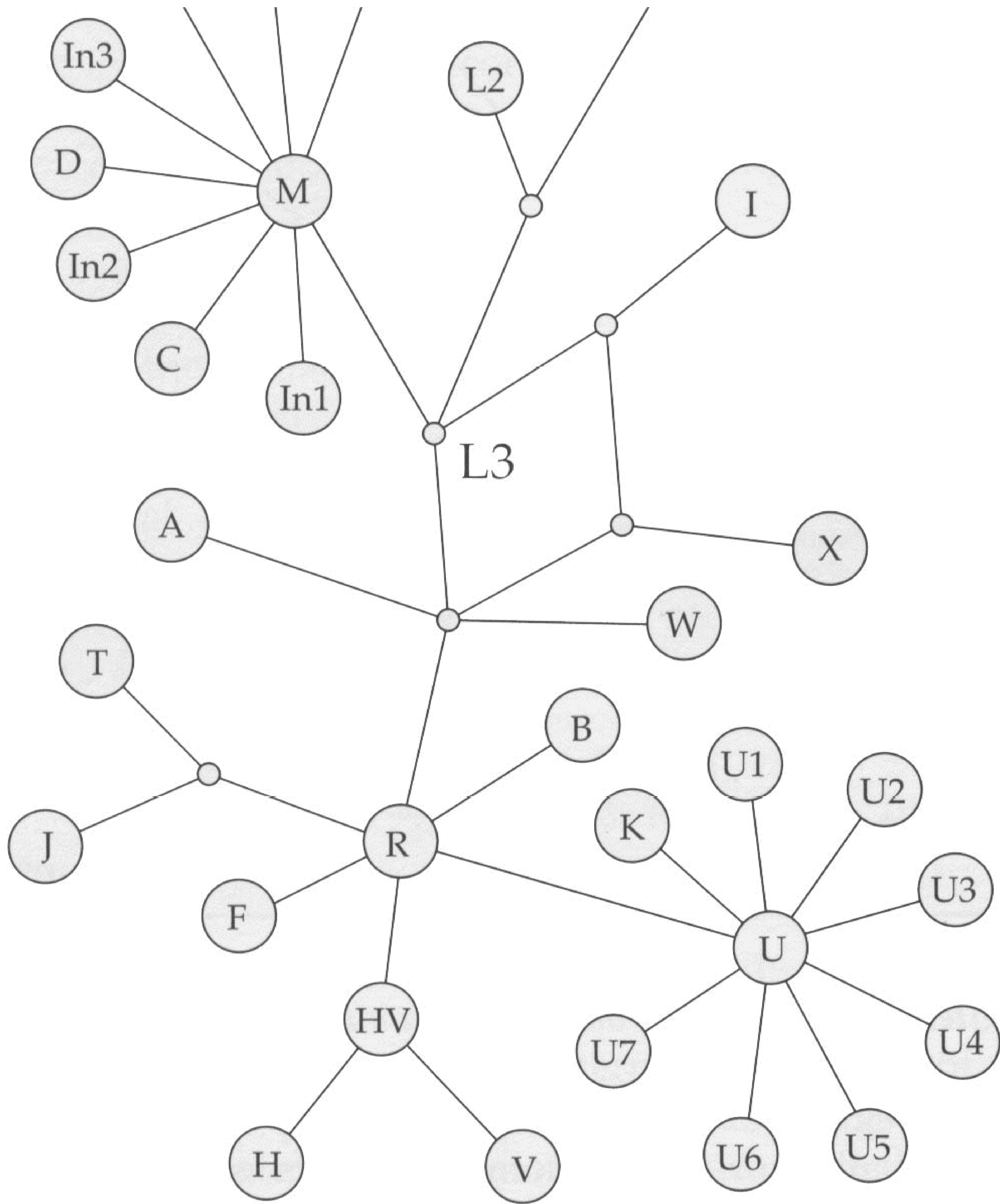


Figure 31.2. *according to Torroizi and Y-chromosom adaptedfrom (clockwise, startiizgfrom noon): Karafet* al. *1999; Previdere*

(M and N). These encompass virtually all mtDNAs i) the expansion of the super-haplogroup

outside Africa, including South Asia. The phylogeans and Mongoloids, including the genesis of the netic node N (including R) has spread its branches region-specific sub-clusters, was clearly separated in all over Eurasia, in contrast to haplogroup M, which

1997; Kivisild *et al*. 1999b; Passarino *et al*. 1996). This
Asian-specific lineage cluster is widespread among
Mongoloid populations (Kolman *et al*. 1996; Torroni

e tal. 1993b; 1994) as well as among Native Ameri- space; ii) since then, there has been only very limited is found in Eastern Eurasia but is virtually absent ingene flow between India and eastern Asia. When cans (e.g. Bonatto &Salzano 1997; Torroni *et al*. 1992;

Europe. The numerous branches of N are, however, did this separation happen? The haplogroup 1993a). Its frequency drops in southeastern Asians,
generally segregated to either the eastern or west
where haplogroups B and F become dominant varie- lescence time for eastern Asians has been estimated ern Eurasian specific pools. The majority of Indian
ties of mtDNA (Ballinger *et al*. 1992; Wallace 1995). as around 55,000-73,000 mtDNAs belong to macro-haplogroup M. While the
We have observed that the frequency of haplogroup cence calculations of Indian haplogroup topology of the M sub-haplogroups, that are comM (Kivisild *et al.* among Indians is even higher than among eastern
mon in mainland East Asia and in Africa, is estabAsians (Table 31.1), ranging from 40 per cent in with this estimate and suggest that the two macro- lished in detail, the internal haplogroup structure of Punjabis to almost a fixation level among Chenchus, populations started to expand simultaneously, per- M in India has remained largely undefined.

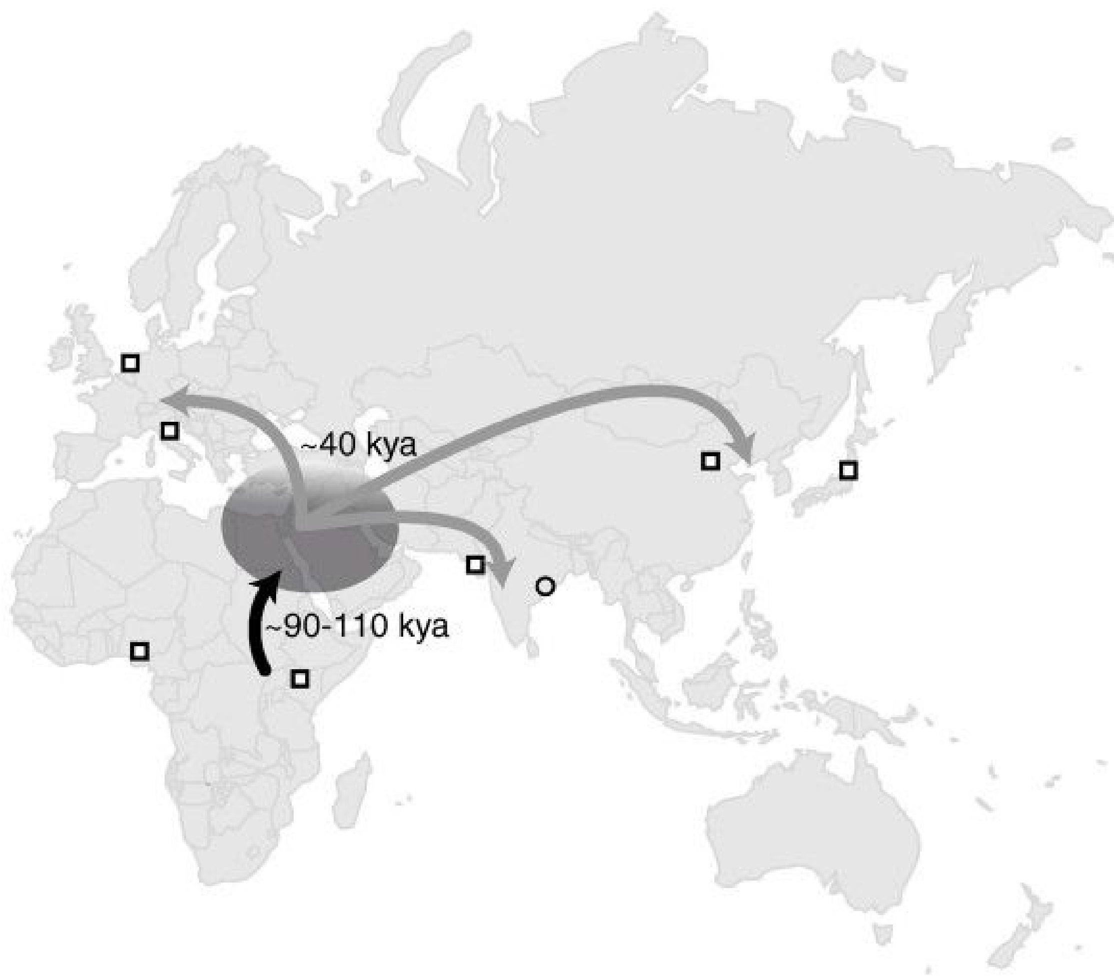
a tribal hunter-gatherer community in Andhra haps due to improved climate between the two major Pradesh (97 per cent; $n = 96$). Studies have shown that the two major miglaciations at about 73,000-65,000 and 24,000-16,000 tochondrial lineages that emerged from Africa (datThere is an important finding, having possibly years ago. The lack of any signs of significant re-
ing to approximately 60,000 years ago, some say
profound implications for the interpretation of the migrations of eastern Asians to India is further sup-

close to 120,000 years ago) are very diverse among ported by the scarcity of mtDNA lineages belonging peopling of southern and eastern Asia, and allowing
a better understanding of the genetic background of to haplogroups A, B and F in India. the populations living in Central Asia. This is that The fact that the Indian and eastern Asian/ the Indian haplogroup M sub-structure (sub-clusters Mongoloid varieties of haplogroup M are so distinct Inl-In4 in Fig. 31.2) differs profoundly from that ob- also allows one to interpret the haplogroup served in Mongoloid populations (Kivisild *et al*. ages found in Central Asian populations phylo-

Indian populations. Additional studies of mitochondrial haplogroups show that an early migration

may have populated the Indian subcontinent, leaving 'relic' populations in present-day India represented by some Austroasiatic and Dravidian-speaking tribal populations (105). These results highlight that the initial peopling of the Indian subcontinent likely occurred early in the history of anatomically modern humans. Concordant with the mitochondrial DNA (mtDNA) data, paternal lineages within India also support a continuous presence of populations on the subcontinent (52).

The high diversity and the deep mitochondrial lineages in India support the hypothesis that Eurasia was initially populated by two major out-ofAfrica migration routes (19,106,107). Populations migrating along an early 'southern-route' originated from the Horn of Africa, crossed the mouth of the Red Sea into the Arabian Peninsula, and subsequently migrated into India, Southeast Asia, and Australia. Later, populations migrated out of Africa along a 'northern route' from northern Africa into the Middle East and subsequently populated Eurasia. This scenario, which is sometimes called the 'delayed expansion' hypothesis (108), predicts that the ancestral Eurasian population separated from African populations long before the expansion into Eurasia. However, the long-term existence of such an ancestral Eurasian population has never been documented.



The 'delayed expansion' hypothesis. In this hypothesis, the ancestal Eurasian population separated from African populations approximately 100 kya but did not expand into most of Eurasia until approximately 40 kya. (*Xing et al. Genome Biology 2010 11:R113***)**

Two rival models based primarily on mtDNA and Y-chromosome data have been proposed to explain the genetic origins of Indian populations. One model suggests that all population groups (including tribes and caste populations) share considerable Pleistocene heritage, with limited recent gene flow

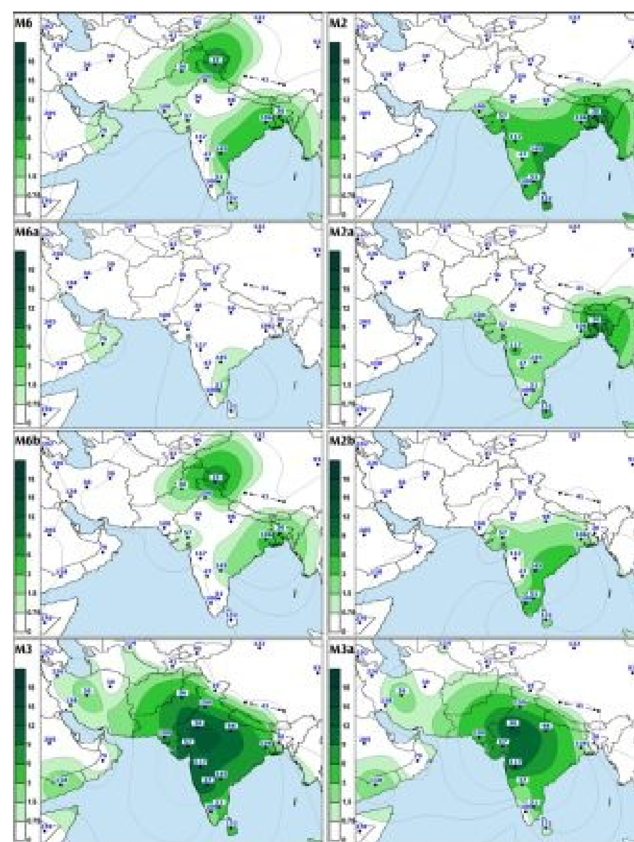
between them (55), whereas an exact opposite view concludes that caste and tribes have independent origins (68).

Maternal Lineages: In India the major maternal lineages, or mitochondrial DNA Haplogroups are M, R, and U, whose coalescence times have been approximated to 50,000 BP (55,59). U is an offshoot of R and is important in its own right in Indian as well as Pakistani context.

The Lineage M: The macro-haplogroup M is an enormous haplogroup spanning many regions. It is the single most common mtDNA haplogroup in Asia and is especially ubiquitous in India. The haplogroup M is believed to have originated in Asia some 60,000 to 75,000 years ago (56,57,58). Haplogroup M is also present in East Asian countries but the South Asian clades of M are mostly different from the East Asian ones. Similarly, virtually all modern Central Asian M lineages seem to belong to the Eastern Eurasian (Mongolian) rather than the South Asian subtypes, which indicates that no large-scale migration from India or Pakistan occurred to central Asia in recent times (59) or earlier. Arguing for the longer term "rival Y-Chromosome model", (52). Stephan Oppenheimer believes that it is highly suggestive that India is the origin of the Eurasian mtDNA haplogroups which he calls the "Eurasian Eves". According to Oppenheimer it is highly probable that nearly all human maternal lineages in Central Asia, the Middle East and Europe descended from only four mtDNA lines that originated in South Asia 50,000-100,000 years ago (109) .

Metspalu, et al (60) found haplogroup M ubiquitous at almost all places in India. Their results indicate that more than 60 per cent Indians have their maternal roots in Indian-specific branches of haplogroup M. The variation among caste populations climbs from approximately 40% in Gujarat and Punjab (Indian) to 65% in the southern states, and peaks at over 70% in West Bengal. They observed a similar geographic pattern among tribal populations, where the frequency varied from just over 50% in the northern states of Punjab and Himachal Pradesh, increased to 70%–80% in the southern states, and peaked at 86% in West Bengal to almost a fixation level (97 per cent) among Chanchus, a hunter-fatherers community in Anther Pradesh.

Among the descendants of M, the lineages M2, M3, M4, M5, M16, M18 and M25 are exclusive to India, with M2 reported to be the oldest lineage on the sub-continent. It is most prevalent in peninsular India but rare in Pakistan. M3 is a numerically important clade: it is widespread through the subcontinent except the Northeast, reaching peaks of *ca.* 20 per cent in Rajasthan. M3a subclade is important among the Parsees of Mumbai and Karachi (22%), M4a is important in Pakistan and Kashmir with only a minor presence in India, and M25 is important in Indian Punjab but surprisingly not fre



all over Eurasia. Most numerous sub-groups of macro-haplogroup N in India are the Indianspecific variants of the phylogenetic node R including haplogroups R5, and R6. There are also lineages stemming straight from the ancestral node N (55).

The haplogroup U represents the most profound overlap between west-Eurasian and Indian mtDNA lineages. It is present throughout India without a clear geographical cline. Indian-specific U2 coalesces with west-Eurasian U2 lineages around 53,000 years ago. Although not an Indian specific haplogroup, U7 is relevant to India. Haplogroup U7 frequency peaks at over 12% in Gujarat, the westernmost state of India, while for the whole of India its frequency stays around 2%. Many European populations lack Haplogroup U7, but its frequency climbs over 4% in the Near East and up to 10% level in the Iranians. Its frequency in Pakistan has been reported to be at 5% but it seems to be a sampling error. The samples were taken from Karachi which presently does not represent the original population of southern Pakistan. The possible home of haplogroup U7 seems to be southern Pakistan and Kutch, because from there its frequency declines steeply both to the east and

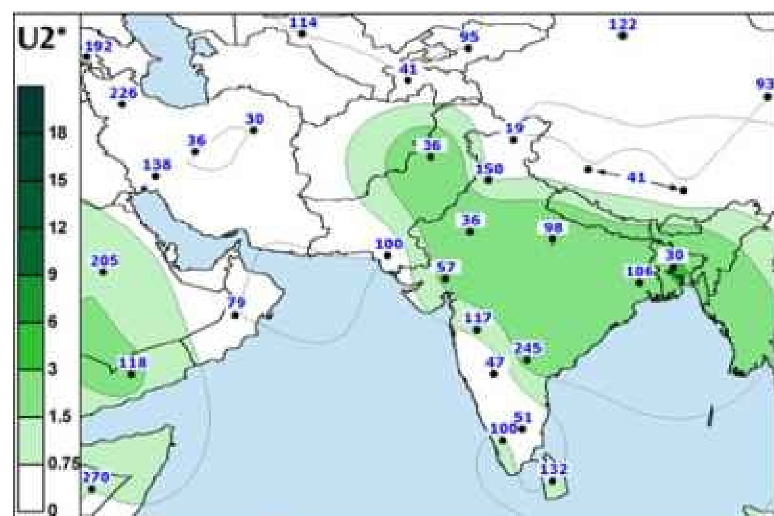
!"#$%&'&()*+!"##$%!to the west. Besides U7, the most frequent mtDNA ())*&++,,,-./0123425)678-401+9$:9;"9<'+ <+"'

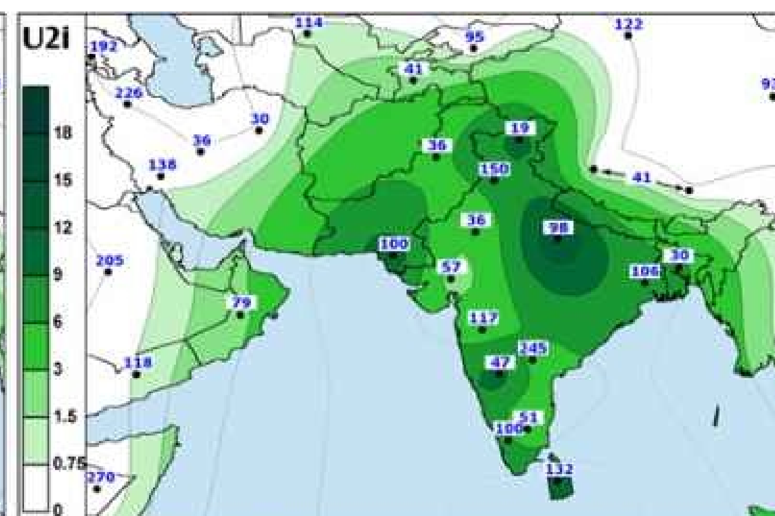
Figure 1.a. The spatial distribution of Indian specific mtDNA haplogroups (M2, M6 and M3) and their sub-haplogroups (60).

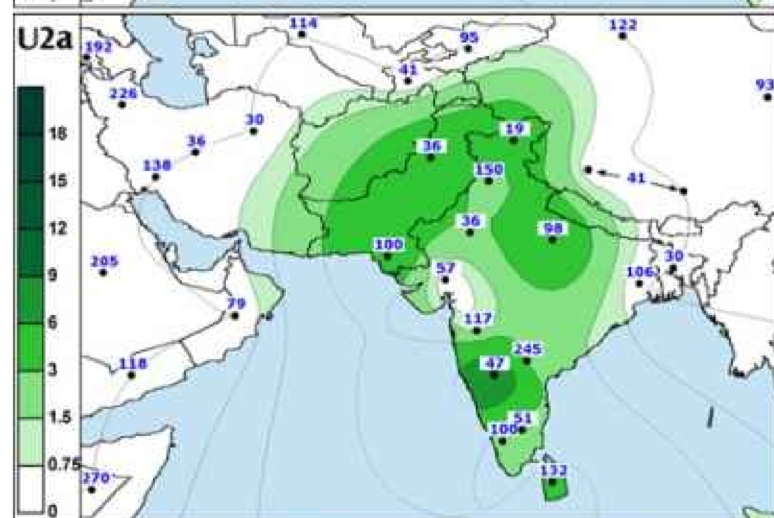
quent in Pakistan. These sub-clusters represent the accumulation of successive mutations along Asian maternal lineages and surprisingly display similar, approximately 40,000 to 50,000 year old, coalescence times.

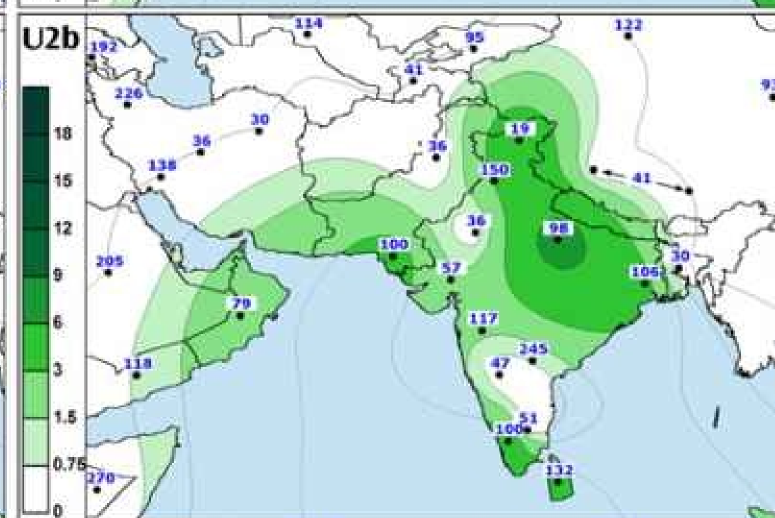
Among non-exclusive M subclasses, M7 and M8 are widespread in East Asian lineages. M6 is primarily found in Pakistan. M1 is present in east Africa, Yemen, and southern Arabia but surprisingly absent from the Indian subcontinent. Figure 1 shows the distribution of some of the India-specific M clades in India and Pakistan. The coalescence times differ from researcher to researcher and subclass to subclass. They generally fall between 40,000 and 60,000 years ago. Some even go as far as 70,000 yeas ago. On the basis of these results, the time of initial colonization of South Asia by modern humans is indicated as early as 70,000 years ago and as late as 50,000 years ago.

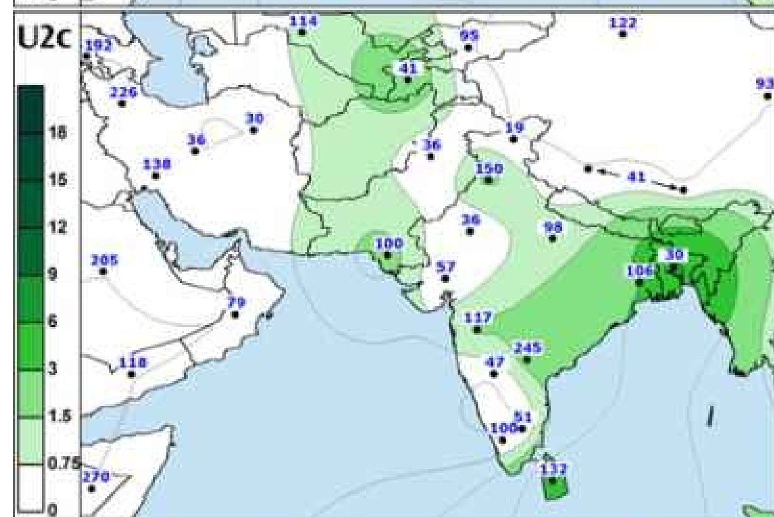
The Lineage N: The haplogroup N, its subclades, and the derivative R constitute the second major subset of Indian mtDNA lineages.

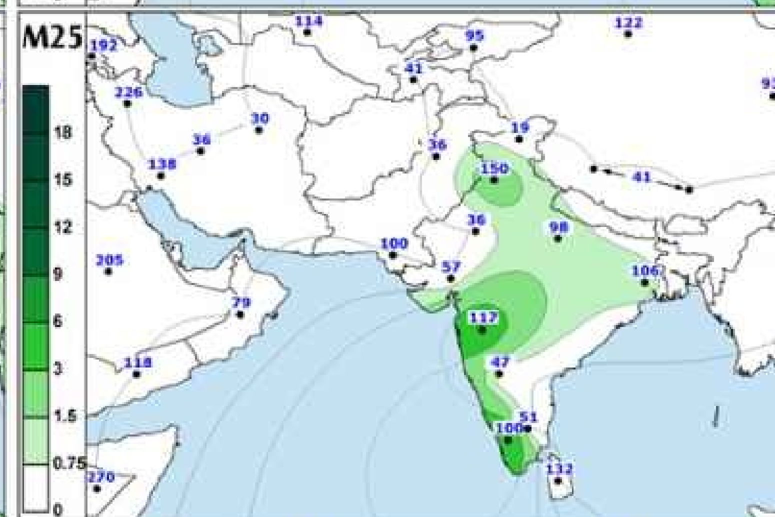

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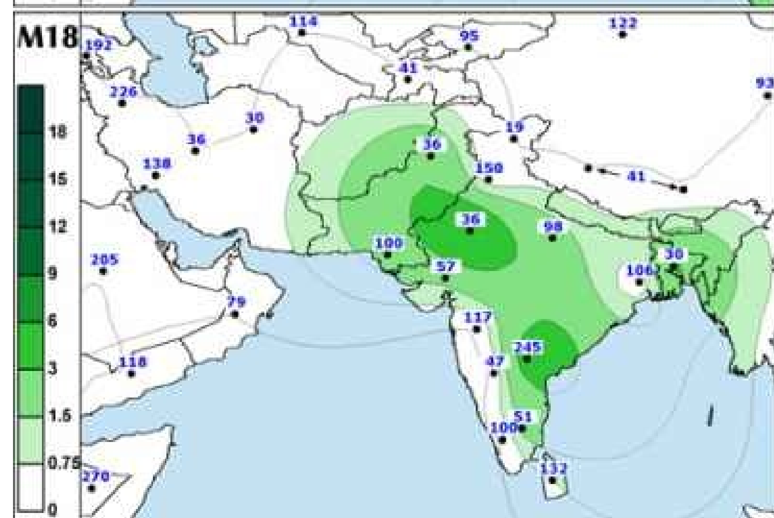

U2i
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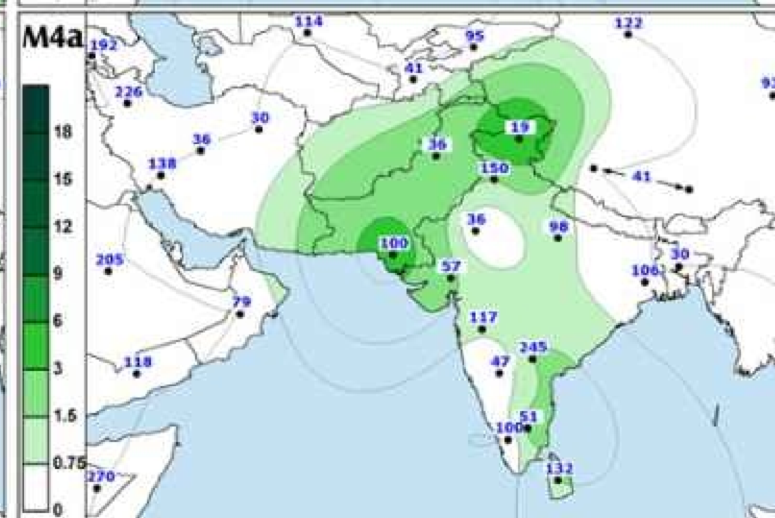

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U2b
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U2c
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M25
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M18
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M4a
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In contrast to haplogroup M, which is virtually The spatial distribution of Indian-specific mtDNA haplogroups (U2, M4a, M18 and M25) and their sub-haplogroups **Fig.1.b. The spatial distribution of Indian-specific haplogroups** absent in Europe, the phylogenetic node N (in

The spatial distribution of Indian-specific mtDNA haplogroups (U2, M4a, M18 and M25) and their sub-haplogroups. In the case of haplogroup M25 some datasets had to be excluded because the discrimination between M* and the respective subgroup was cluding its derivative R) has spread its branches not possible on the basis of the HVS-I data alone (see footnote of Table 3). For other details see legend to Figure 1.

haplogroup in India that derives from the phylogenetic node N is haplogroup W. The frequency peak of haplogroup W is 5 % in the north-western states. Elsewhere its frequency is very low, forming a significant spatial cline.

=7>2!'!0?!"< *,-./&$'012&3$'4(543*)(.()4'$-03-4+&+6*

The Antiquity of Indian-specific mtDNA Lineages: Among the most contentiously debated issues is about the people who initially settled the Indian subcontinent. It has been commonly suggested that the communities affiliated to the AustroAsiatic linguistic family are perhaps the first to settle India, particularly the north-eastern parts of the country. Recent speculations, based on both traditional genetic markers seem to corroborate this view (61). However, these studies are inadequate both in terms of the representation of the constituent groups within this broad linguistic category as well as the number of samples that represent each of them.

The more recently accumulated genetic data indicate that the initial dispersal of modern humans in India, in fact the whole of South Asia, may have occurred at any point within the past 70,000 to 50,000 years. It is evident that the earliest *Homo sapiens* fossils recovered from the region may not have been the first anatomically modern humans to have reached the subcontinent and the use of the early fossils from Sri Lanka as evidence for a definitive date for such a dispersal is a misuse of the paleoanthropological record. In fact, the dates of the Sri Lanka fossils could be the latest date for the colonization of the region by Homo *sapiens*.

Y-Chromosomal Studies: The analysis of Ychromosome is a widely used genetic for assessing the origins of populations along the paternal descent line. Most Indian communities trace their origin along the male '*gothra*' or clan, which is often the basis of endogamous marriage networks. It is notable that the *gothra* system exists in caste as well as in tribal populations. Sahoo et al (63) studied the Ychromosome haplogroups of a large number of Indian populations. They detected a total of 18 Y-chromosome haplogroups in 936 samples. According to their data, Y-chromosome haplogroups R1, R2, L, O, H, J2, and C, together, characterize more

than 90% of the Y-chromosomal variation in all socio-linguistic **and excluded from the main maps. The data for caste populations are averaged to the** groups of India. Both Indo-Iranian **level of states in India. Because of different phylogenetic resolution different sets of** and Dravidian-speaking popula**published data are used for different haplogroup maps (63)**

tions show a high combined frequency of haplogroups C*, L1, H1, and R2. In turn, haplogroups E, I, G, J*, and R1* have a combined frequency of 53% in the Near East among the Turks and 24% in Central Asia, but they are rare or absent in India. Similarly, haplogroups C3, D, N, and O, specific to

Central Asians, are virtually absent in India. Only haplogroups J2 and R1a have interregional frequency patterns comparable to west of India with J2 being most common in Afro-Asiatic-speaking populations of the Near East and Middle East. R1a occurs at the highest frequencies in populations of India, Pakistan, East Europe, and Central Asia. The O2a and O3e subclades of haplogroup O in India also have interregional distributions, overlapping with those of Southeast Asia and East Asia but absent in Pakistan. The predominance of the O haplogroup and its sublineages in populations of Eastern and Central Indian suggest a Southeast Asian origins of Indian Austro-Asiatic and Tibeto-Burman speakers, with the latter being likely very recent immigrants. This geographical distribution is displayed in Figure 2.

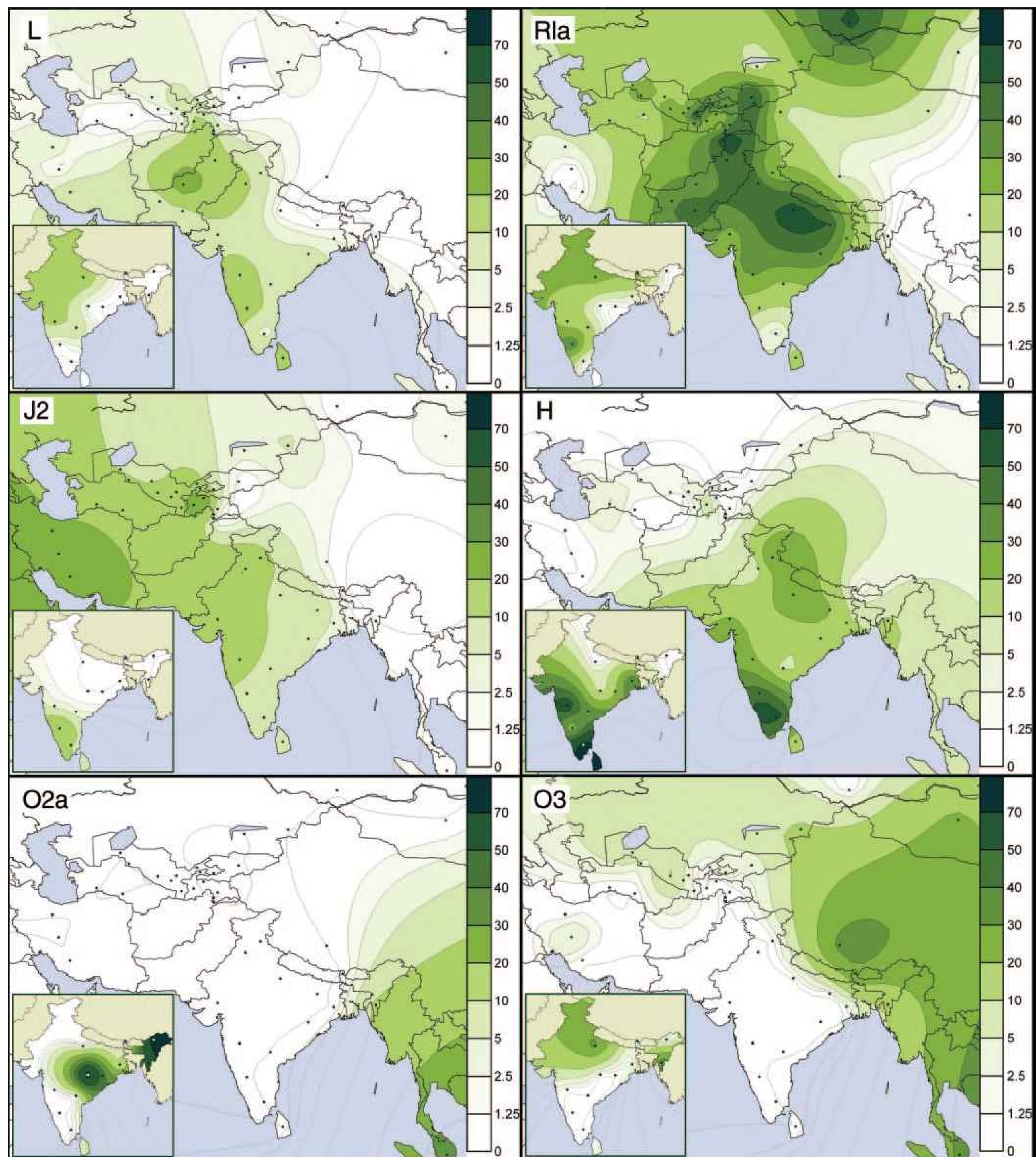


Figure 2. Spatial frequency distribution maps of major Y-chromosome haplogroups in South Asia. For India, the data on tribal populations are shown in the inset maps

Considering individual haplogroup frequencies within each of these geographical regions, no consistent pattern is detected in the distribution of the Y haplogroups to distinguish either the castes from the tribes, or Dravidians from the IndoIranians. However, some faint clines appear to center in

North India (R1a), Northwest India (J2), South India (H), and East India (R2). These clines display distinct regional concentrations of J2, H, R1a, R2, O3, and O2a, confirming the primarily geographic nature of Y-chromosome frequency distribution. While J2, H, R1a, and R2 represent the western affiliation, O3 and O2a represent the eastern influence. J is the predominant Y-chromosome haplogroup in populations living west of India.

The usually strong correlation of haploid Ychromosome diversity with geography makes it a particularly effective gauge of both range and population expansions. As the global architecture of the Y-chromosome phylogeny has become well defined and refined, the complex Y-chromosome binary haplogroup diversity of southern Asia has begun to be described, revealing an intricate composition and phylogeography concomitant with the initial and subsequent repeated colonization events of South Asia, generally consistent with that reported for mtDNA (53,72).

To a considerable extent, molecular studies of haploid mtDNA and Y-chromosome structure in India have been framed in the context of the contemporary social hierarchy and/or linguistic fabric of various groups. Although such studies have provided interesting insights into the genetic history of paternal lineages in India, there have been two main limitations arising from a combination of ethnically ill-defined populations, limited geographic sampling, inadequate molecular resolution, and inappropriate statistical methods. Another underappreciated factor in some studies is the innate complexity of caste origins, including the recognition that some castes may have tribal origins. Sengupta et al undertook a substantially large study, where these deficiencies have been minimized by using a combination of more-extensive population sampling and higher molecular resolution. (52). Although it is generally accepted that Indo-European languages were introduced to present-day India relatively recently (~3,600 years ago) (110), interpretations differ regarding their influence on the pre-existing gene pool (55,68).

Y-Chromosomes Lineages: Most of the Ychromosome DNA studies in India have been undertaken to resolve the Indo-European question and the caste-versus-tribal issue. Several studies have argued that, in contrast to the relative uniformity of mtDNA (indicating large genetic distance), the Y chromosomes of Indian populations display relatively small genetic distances to those of West Eurasians (64), linking this finding to recent migrations from the West. Some studies have suggested haplogroup R1a, with its wide geographic spread including Eastern Europe and Central Asia, as a potential marker of the Indo-Aryan invasion that introduced the caste system to India. To bolster this claim, the higher frequency of this haplogroup among the higher caste groups is pointed to. For example, Wells *et al*. (44) highlighted R1a (M17) as a potential marker for such an event. Within the subcontinent, R1a is more common in Pakistani populations than those of India. This is offered as an argument for an Indo-Aryan migration from the west to the East.

Several other researchers, on the other hand, have argued against such a simple, essentially single alpha-male lineage initiated migration scenario (65,66) The higher variance of STRs in the Indian R1a lineages as compared to those from Central Asia weakens such a scenario, implying a strong founder effect in Central Asian populations.The concept of receiving a major malespecific gene flow from Central Asia seems to be as untenable as that pertaining to female-specific gene flow and this is notwithstanding the known migrations and invasions from this areas in historic times.

Departing from the “one haplogroup equals one migration” scenario, Cordaux *et al*. (68) defined, heuristically, a package of haplogroups (J2, R1a, R2, and L) to be associated with the migration of

Indo European peoples and the introduction of the caste system to India, again from Central Asia, because they had been observed at significantly lower proportions in South Indian tribal groups. This package has also been variously linked to the language and agriculture, arriving in Pakistan and later guage and agriculture, arriving in Pakistan and later 10,000 years ago. This concept, like that of the Aryan Invasion 3500 years ago, also does not hold up on closer scrutiny by the simple fact that the distribution of haplogroup frequencies are predominantly driven by geographical, rather than by cultural determinants. Ironically, it is in the northeast of India, among the tribal groups that there is clear-cut evidence for large-scale demic diffusion traceable by genes, culture, and language, but apparently not by agriculture. The studies undertaken in Pakistan confirm this general conclusion where largely an independent origin of agriculture and animal domestication has now been generally accepted. The oft quoted relationship between the demic diffusion of agriculture and animal domestication from the Middle East to various parts of the Old World seems to be stemming from the clear and well documented migration of the Levant farmers to Europe and the beginning of agriculture there. This does not have any parallel anywhere, especially the area under consideration.

Sahoo et al (63) analyzed a large number of Y-chromosomes representing 32 tribal and 45 caste groups from all four major linguistic groups of India. Genetic distance and admixture analyses all indicate that the recent external caste groups has been really chromosomal data consistently suggest a largely South Asian origin for Indian caste communities and contribution to

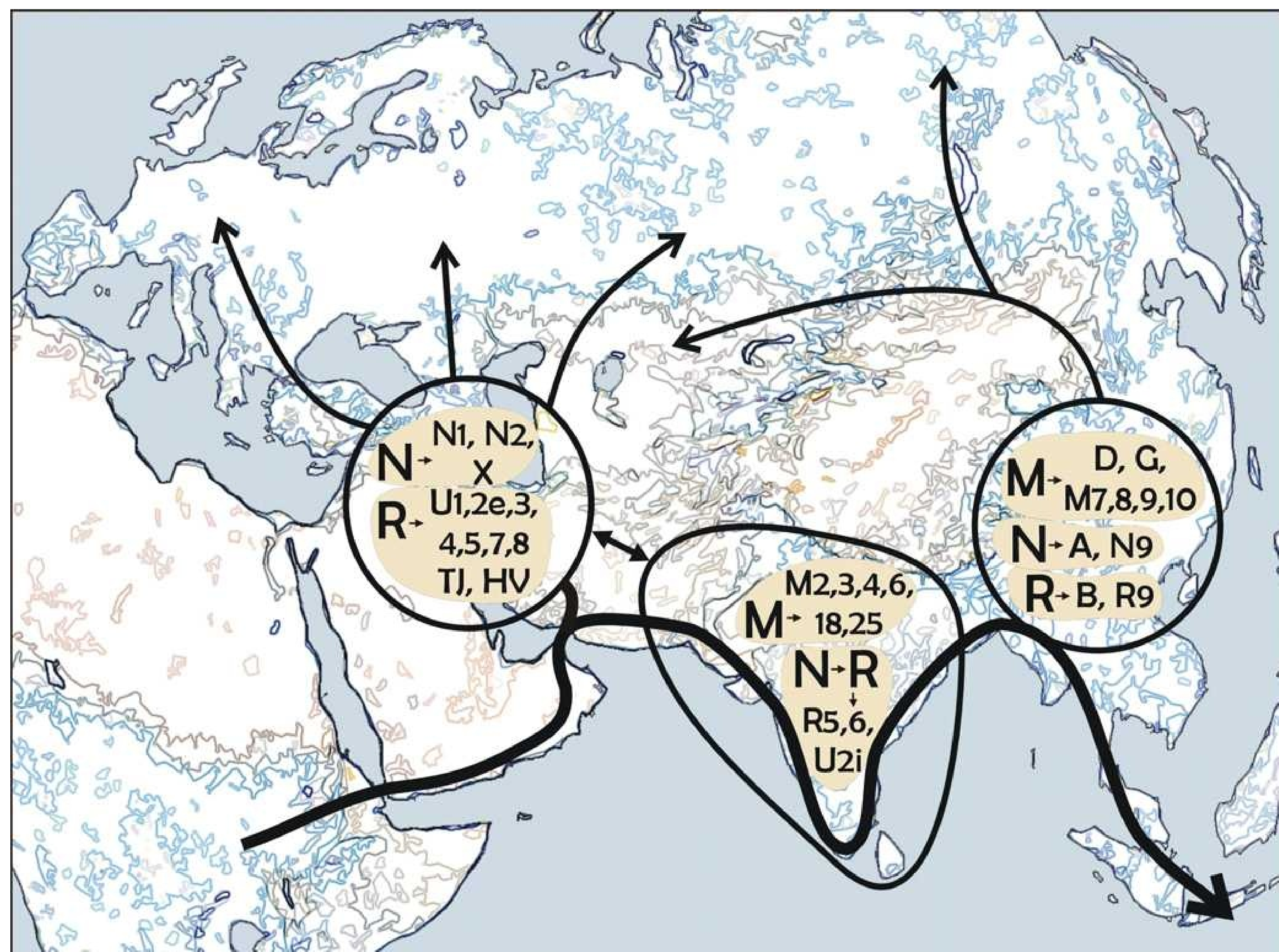
low. The Ytherefore argue against any major influx, from regions north and west of India, of people associated either with the development of agriculture or the spread of the Indo-Aryan language family.

“Theperennialconceptofpeople,language, and agriculture arriving to India together through Punjab corridor does not hold up to close scrutiny and the claims for a linkage of haplogroups J2, L, R1a, and R2 with a contemporaneous origin for the majority of the Indian castes' paternal lineages from outside the subcontinent are not valid. As stated above, the current distributions of haplogroup frequencies are, with the exception of the O linea!"#$%&'&()*+!"##$%!!&'"ges, predominantly driven by geographical, rather

than cultural determinants. Ironically, it is in the northeast of India, among the TB groups that there is clear-cut evidence for large-scale demic diffusion traceable by genes, culture, and language, but apparently not by agriculture” , critiques Sahoo (63).

Gene Flow from the West: The genetic influence of the West on the Indian population groups should be logically viewed in terms of the gene flow from Pakistan. Geographically, Pakistan is connected with India through a long border but communication-wise it is really short. The populations from Baluchistan and the Pashtun country do not have any connection with those of India. The contact points between the populations of Sindh

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and Punjab with those of the neighboring areas of India have been limited - only two narrow corridors,



Peopling of Eurasia

Fig.5. Peopling of Eurasia. Map of Eurasia and northeastern Africa depicting the peopling of Eurasia as inferred from the **Peopling of Eurasia.**

Map of Eurasia and northeastern Africa depicting the peopling of Eurasia as inferred from the extant extant mtDNA phylogeny.The bold black arrow indicates the possible "coastal" route of colonization of Eurasia by anamtDNA phylogeny. The bold black arrow indicates the possible "coastal" route of colonization of Eurasia by anatomically mod

tomically modern humans (ca. 60,000 – 80,000 years ago).This "Southern Coastal Route" is suggested by the phyloern humans (ca. 60,000 – 80,000 ybp.). This "Southern Coastal Route" is suggested by the phylogeography of mtDNA haplo

geography of mtDNA haplogroup M, the virtual absence of which in the Near East and Southwest Asia undermines the group M, the virtual absence of which in the Near East and Southwest Asia undermines the likelihood of the initial colonization

likelihood of the initial colonization of Eurasia taking a route north around the Red Sea.Therefore, the initial split beof Eurasia taking a route north around the Red Sea. Therefore, the initial split between West and East Eurasian mtDNAs is tween West and East Eurasian mtDNAs is postulated between the Indus Valley and Southwest Asia. Spheres depict expostulated between the Indus Valley and Southwest Asia. Spheres depict expansion zones where, after the initial (coastal)

pansion zones where, after the initial (coastal) peopling of the continent, local branches of the mtDNA tree (hap
peopling of the continent, local branches of the mtDNA tree (haplogroups given in the spheres) arose (ca. 40,000 – 60,000
logroups given in the spheres) arose (ca. 40,000 – 60,000 years ago), and from where they where further carried into
ybp), and from where they where further carried into the interior of the continent (thinner black arrows). Admixture between the interior of the continent (thinner black arrows).Admixture between the expansion zones has been surprisingly lim
the expansion zones has been surprisingly limited ever since. We note that while there is no obvious need to introduce the ited ever since.We note that while there is no obvious need to introduce the "northern route" – from northeast Africa
"northern route" – from northeast Africa over Sinai to the Near East – to explain the initial colonization of Eurasia, the spread
over Sinai to the Near East – to explain the initial colonization of Eurasia, the spread of some mtDNA and Y
of some mtDNA and Y-chromosomal haplogroups implies that the "northern" passage might have been used in a later period [33, 34].chromosomal haplogroups implies that the "northern" passage might have been used in a later period (60). 262
western Iran (Figure 1, panel M3a) – the historic origin of Awaiting further information from complete mtDNA the Zoroastrian Parsees. In addition to the Parsees we sequences, we defined haplogroup M18 by using the
*!"#$%&'&()**+!"##$%!!&'" The Stone Age

one in the northeast along the Siwaliks, connecting northern parts of the Indian and Pakistani Punjab; the other along a narrow coastal strip connecting Gujarat and Sindh through Kutch. In between these two points lies the great desert, the Thar, through which the present boundaries between India and Pakistan run. These geographic features allowed the gene flow largely through the two corridors mentioned adove and this is evident from the genetic diversity around these nodes.

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Indian populations share with those of Pakistan and

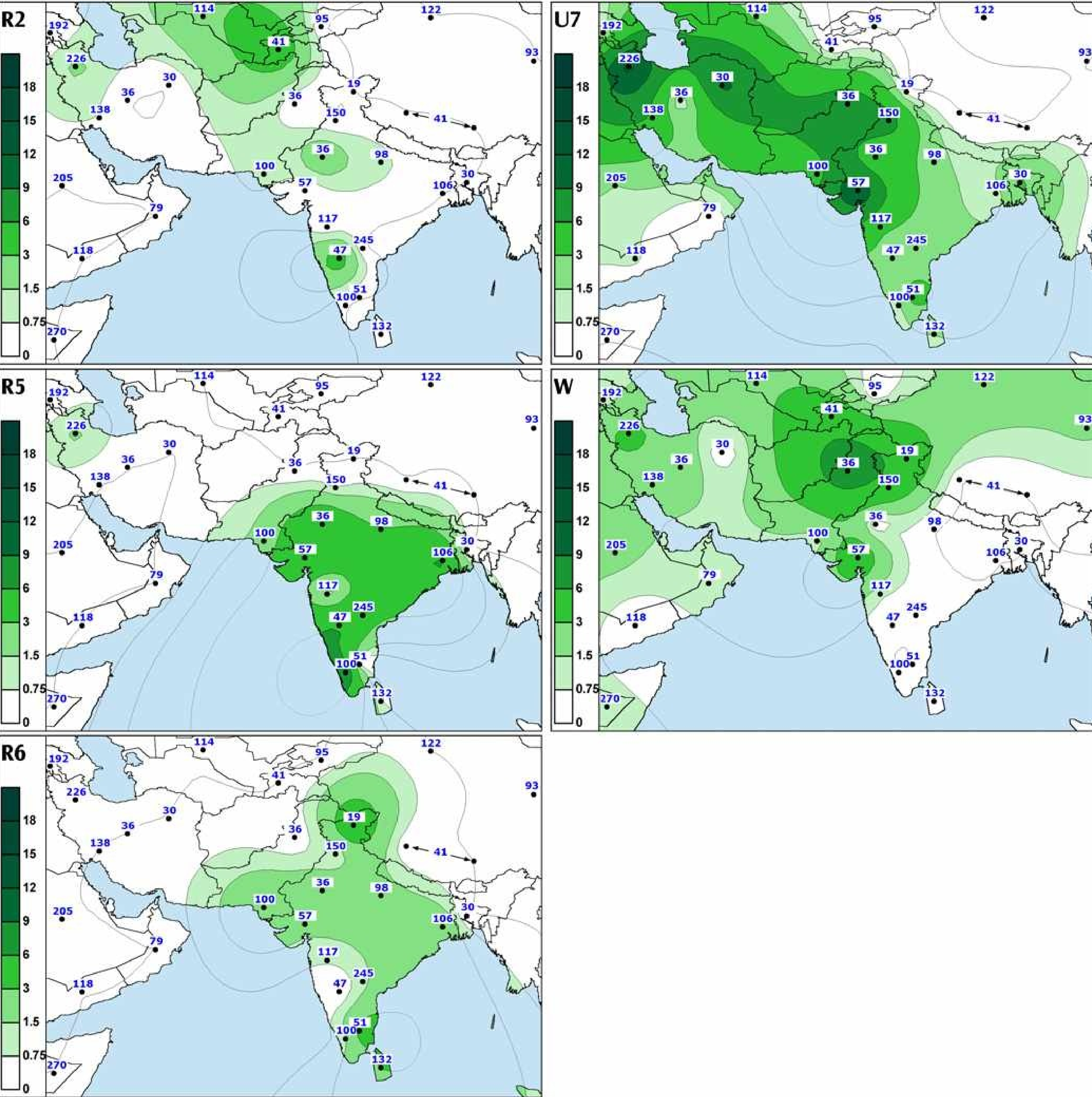
the West are W, U7, and R2. All of them consist of basal deep-rooting branches of haplogroup R, which is itself an offshoot of N. This link is as ancient as the Out-of-Africa migration and cannot be construed to be an admixture of the West with India in the more recent times. Most likely, this is a genetic continuum that spans from the Near East to Pakistan and further on to India, as well as extending north into Central Asia. The coalescence times of these haplogroups suggest that this continuum took shape somewhere between 30,000 to 50,000 years ago, thus falling within the climatically favorable interglacial period. Table 1 depicts the approximate coalescence time of these haplogroups for India and compares them with those of the Near East and Central Asia.

Broadly, the average proportion of mtDNAs from West Eurasia among Indian caste populations is 17% (60). In the western States of India and in Pakistan their share is greater, reaching over 30% in Kashmir and Gujarat, nearly 40% in Indian Punjab, and peaking, expectedly, at approximately 50% in western Punjab, reaching a figure as high as 65% and higher across the Indus River (see the next chapter). These frequencies demonstrate a general decline towards the south and even more so

towards the east of India (13% in Uttar Pradesh and around 7% in West Bengal and Bangladesh). The low (<3%) frequency of the western Eurasian mtDNAs in Rajasthan is due to impeded contacts between the population groups across the Thar Desert.

In comparison to an overall frequency of 17% among the caste populations, only 7% of the mtDNAs from the tribal groups show affiliation to the West Eurasian haplogroups (60). The observed dif

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The spatial distribution of Indian-specific mtDNA haplogroups (R5 and R6) and West Eurasian-

specific U7, W and R2 in South

Fig.6. The spatial distribution of West-Eurasian-specific

The spatial distribution of Indian-specific mtDNA haplogroups (R5 and R6) and West Eurasian-specific U7, W

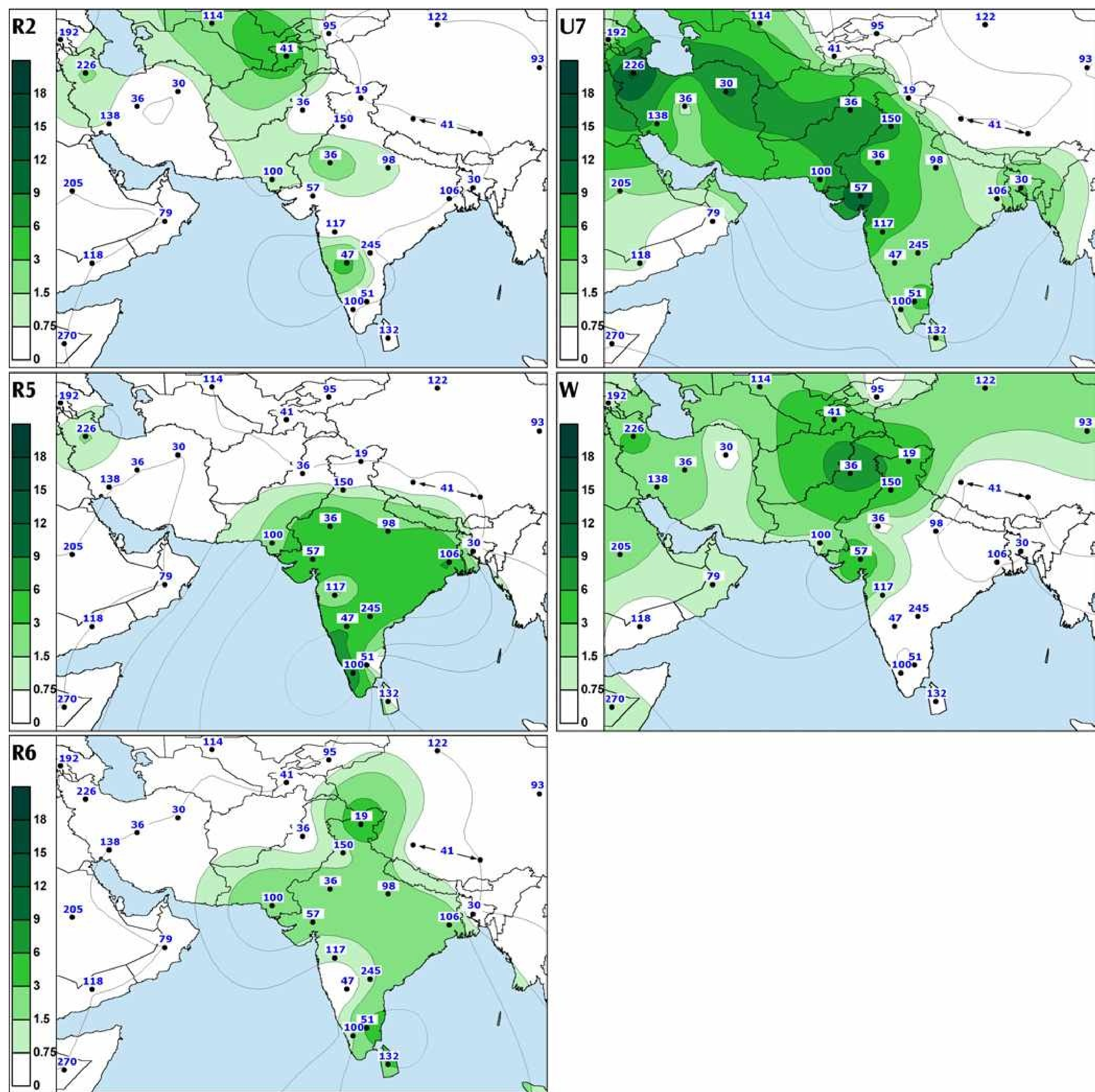
mtDNA haplogroups in India and Pakistan

and R2 in South and southwest Asia. For other details see legend to Figure 1.

ference could be caused by differences in the extent of gene flow from the Indus Valley to different (around 50,000 – 70,000 ybp). Together they constitute likely to be extended when more mtDNA coding region

Table 1. Coalescence estimates and diversity values for mtDNA haplogroup U7,W, and R2 in India Central Asia, and the information will become available for the M* lineages in **Near East (60)** nearly 15% of the Indian mtDNAs. Importantly, these

haplogroups are virtually absent elsewhere in Eurasia India. [13,15], this study]. Because most of Indian varieties of haplogroup M are still unclassified (M*), this package is



The spatial distribution of Indian-specific mtDNA haplogroups (R5 and R6) and West Eurasian-specific U7, W and R2 in South The spatial distribution of Indian-specific mtDNA haplogroups (R5 and R6) and West Eurasian-specific U7, W and R2 in South

The spatial distribution of Indian-specific mtDNA haplogroups (R5 and R6) and West Eurasian-specific U7, W

The spatial distribution of Indian-specific mtDNA haplogroups (R5 and R6) and West Eurasian-specific U7, W and R2 in South and southwest Asia. For other details see legend to Figure 1.

Table 4: Coalescence estimates and diversity values for mtDNA haplogroups U7, W and R2 in India, Central Asia, Near and Middle East.

HAPLO-GROUP	INDIA		NEAR AND MIDDLE EAST		CENTRAL ASIA	
	COALESCENCE (years)	DIVERSITY	COALESCENCE (years)	DIVERSITY	COALESCENCE (years)	DIVERSITY
U7	41,400 ± 15,800	0.941	41,200 ± 14,800	0.91	34,400 ± 15,500	0.941
W	37,900 ± 11,100	0.883	32,000 ± 8,700	0.934	27,400 ± 8,300	0.758
R2	40,400 ± 14,300	0.923	36,100 ± 11,100	0.955	25,200 ± 13,300	0.889

263 (around 50,000 – 70,000 ybp). Together they constitute
(around 50,000 – 70,000 ybp). Together they constitute

nearly 15% of the Indian mtDNAs. Importantly, these nearly 15% of the Indian mtDNAs. Importantly, these **haplogroups are virtually absent elsewhere in Eurasia** [13,15], this study]. Because most of Indian varieties of

[13,15], this study]. Because most of Indian varieties of
haplogroup M are still unclassified (M*), this package is likely to be extended when more mtDNA coding region
likely to be extended when more mtDNA coding region

information will become available for the M* lineages in information will become available for the M* lineages in **India.**

social layers of the Indian society (64), and/or a more pronounced genetic drift among the tribal groups.

The western Eurasian contribution to the Indian maternal gene pool can be broadly divided into two different components. Over two thirds of the West Eurasian-specific mtDNAs found in India are made up by haplogroups HV, TJ, N1 and West Eurasian-specific branches of haplogroup U. It is likely that these mtDNA haplogroups have been carried to western India both by relatively lowintensity long-lasting admixture at the border regions as well as a consequence of numerous but probably limited migrations during the last 10,000 years (72). The remaining one third of the West Eurasian-specific mtDNAs found in India is comprised of haplogroups U7, R2 and W showing much

Figure 3. Partial map of Eurasia illustrating the spatial frequency distribution

maximum, which is well documented in paleovegetation reconstructions may explain the observed segregation (60). The later migrations from the West are probably represented by the minor share of lineages nested in these and other haplogroups, such as in TJ (1.7%), U5 (0.20%), U4 (0.16%), and K (1.3%), the exact source and timing of which migrations is difficult to establish. Significantly, these lineages are more noticeable in the north-western region of India, around the oft-cited northern corridor of contact between Pakistan and India (60). Similarly to HV, TJ, N1, the spread of U7, W and R2 in India is geographically uneven – the three haplogroups are much more frequent in the northwestern states . Together, they constitute nearly 14% of the maternal gene pool in Indian Punjab, Gujarat and Rajasthan. Their frequency is also

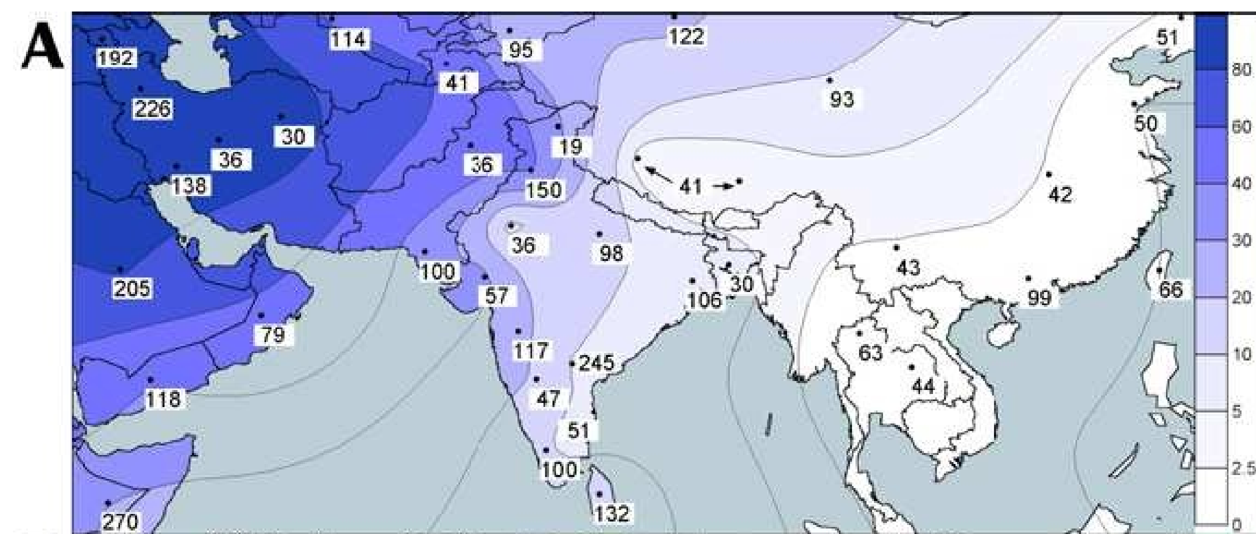
of mtDNA haplogroups native to West Eurasia.

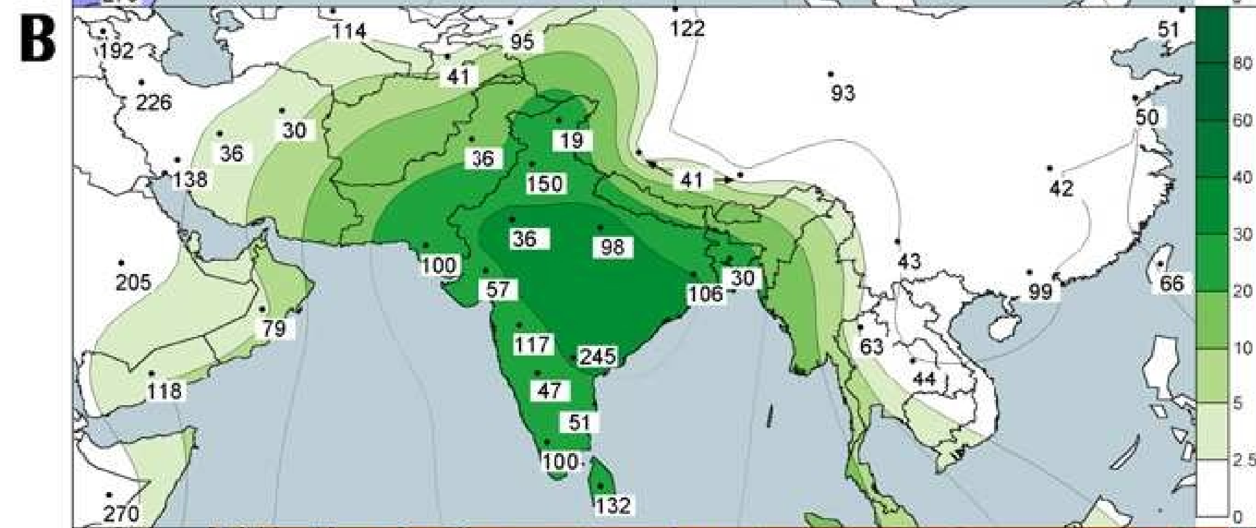
high in Iran (13%) and Pakistan (10%) but declines in Central Asia (5%).

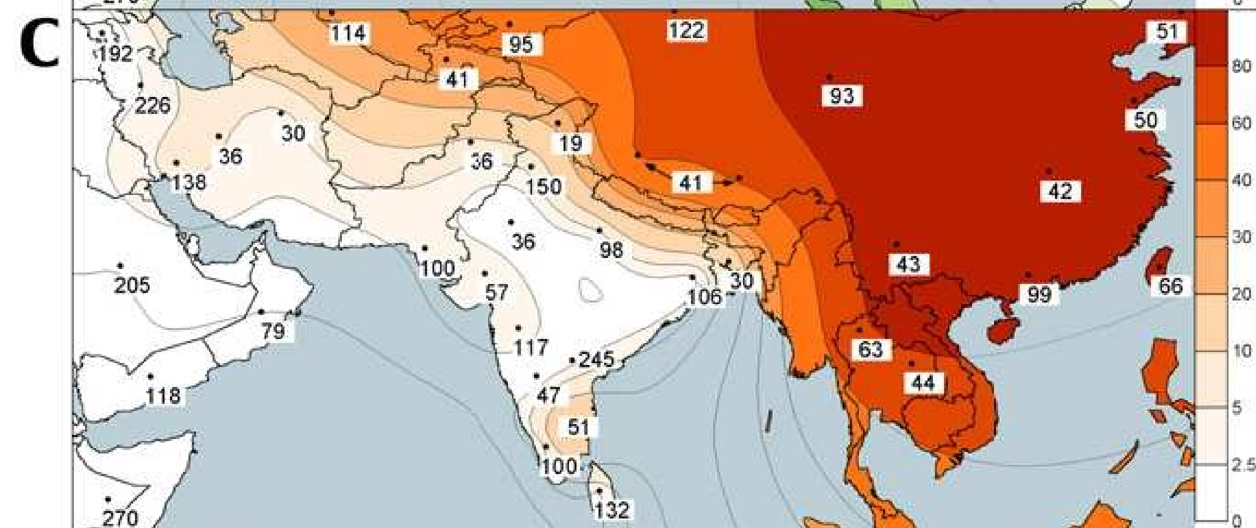
Haplogroup R2 appears at low frequencies in Near and Middle East and India and is virtually absent elsewhere. The spread of haplogroup R2 in Europe is restricted to a few populations in the Volga basin where it is represented by nodal haplotypes and by a region-specific subclass. The coalescence estimate of this sub-clade is reporterd to be 11,400 ± 9,000 years ago. This wide error range prevents one from drawing any firm conclusions.

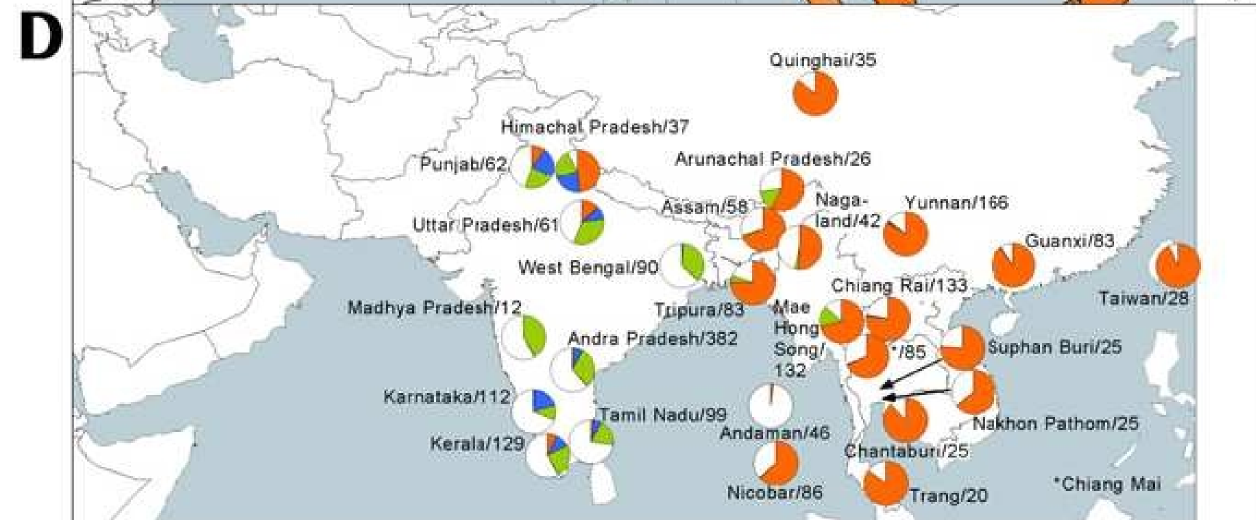
deeper time depths in India – approximately forty thousand years before present (60). A large-scale immigration – carrying these haplogroups – could have introduced a substantial fraction of the diversity already present within the putative source areas. This would explain the deep coalescence times of these haplogroups in India, while their actual arrival could have occurred later. Alternatively, the coalescence estimates may indeed reflect a deeper autochthonous history of these mtDNA clades in India. It is worthwhile to stress that while in India the share of U7, R2 and W in the West Eurasian-specific mtDNAs mounts to nearly a third, in Iran it stays below 15%.

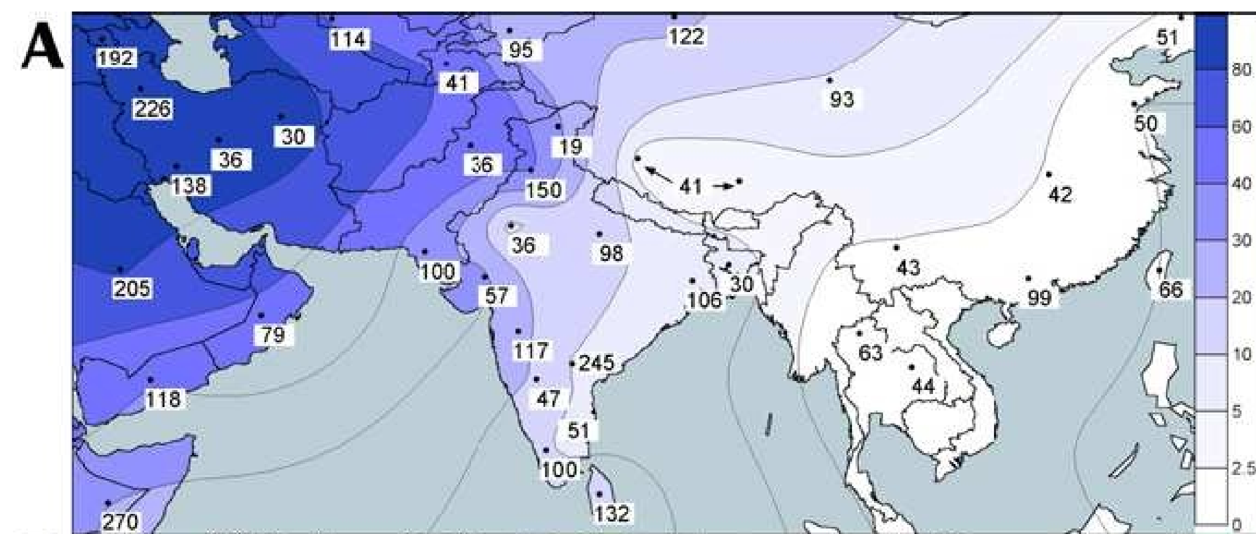
Figure 3 depicts the depth of Western gene pool across the subcontinent. It represents the distribution of the “western” genes across Pakistan and India. A continuum of gene spread and it decreasing cline to the east is evident. The research on the Iranian-specific U7 clades suggest that the timewindow of this continuum was probably closed by *ca.* 20,000 years ago. The inferred extreme aridity of eastern Iran and Pakistan during the last glacial

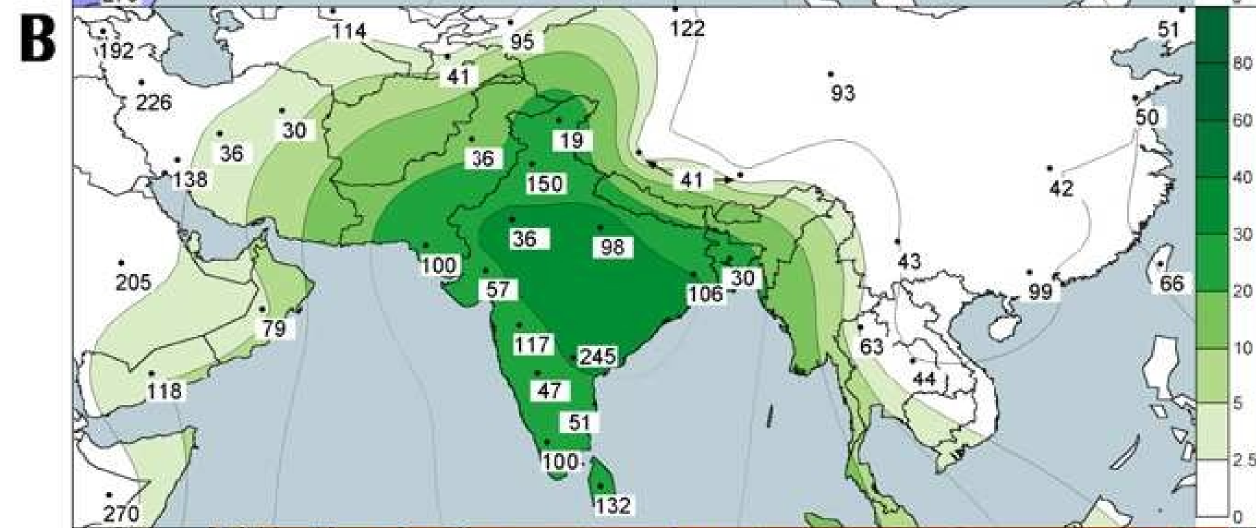

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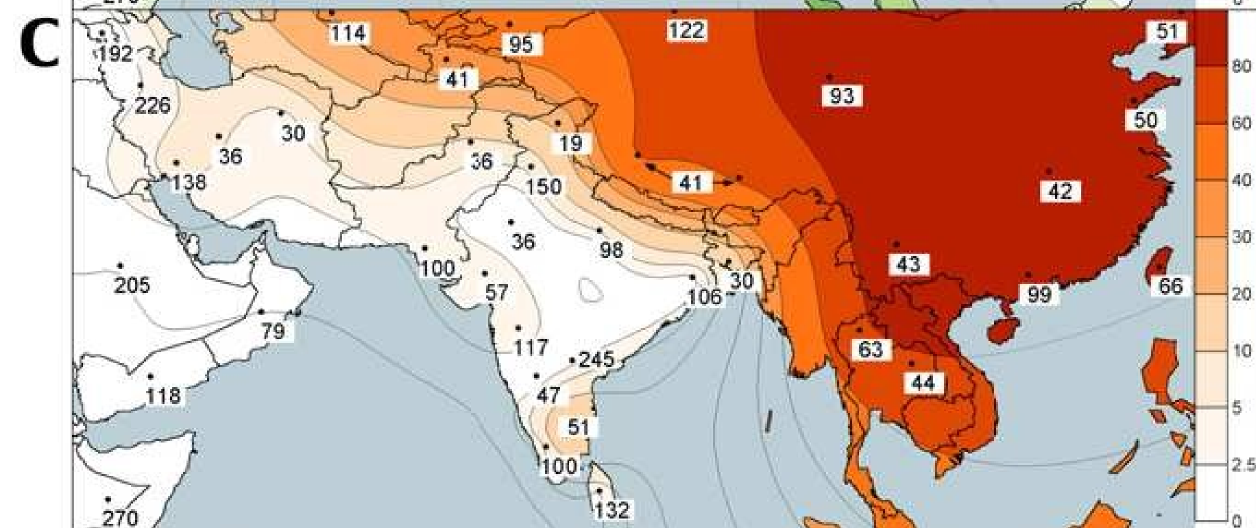

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Andaman/46
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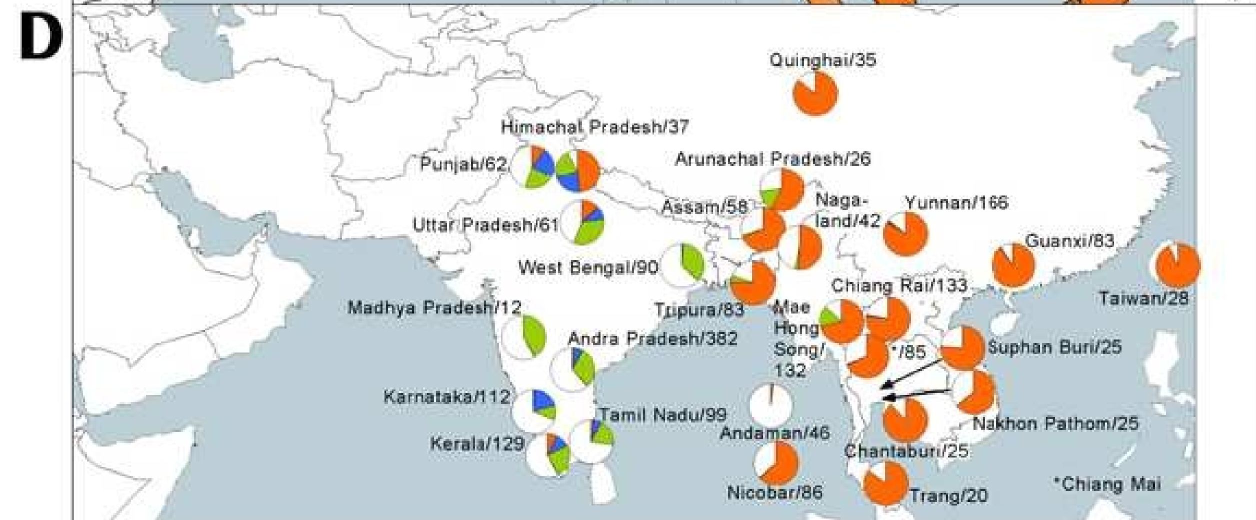

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Karnataka/112
Tamil Nadu/99
Andaman/46
Nakhon Pathom/25
Kerala/129
Chantaburi/25
Nicobar/86
Trang/20
*Chiang Mai

Figure 4. Geographical distribution of eastern-specific haplogroups. Notice their virtual absence in India and Pakistan, beyond extreme northern regions (60)

To summarize, the West and South Asian phylogeography of haplogroups W, U7 and R2 can be viewed as a genetic continuum that spans from the Near East to Pakistan and into India, extending north into Central Asia. The coalescence times of these haplogroups suggest that this continuum took shape somewhere between 30,000 to 50,000 years ago (Table 1), thus falling within the climatically favorable interglacial period. We notice that the extant U7 and W frequencies along the proposed continuum are not uniform. U7 is more predominant in Iran, Pakistan, northwestern India and the Arabian peninsula, while W is more frequent in the western Near-East, Anatolia and the Caucasus. The coalescence ages of the Indian- and Iranian-specific U7 clades suggest that the time-window of this continuum was closed by ca. 20,000 years ago. The inferred extreme aridity of eastern Iran and western India during the last glacial maximum, which is well documented in paleovegetation reconstructions (42)may explain the observed segregation.

Gene flow from East Eurasia: The East Asian-specific mtDNA haplogroups are less common in India and even less in Pakistan. They are geographically sharply segregated. This is shown in Figure 4. An important conclusion can therefore be drawn: during the last 50,000 years or so, there has been a very limited admixture of Indian populations with the mongoloid populations living east and north of India and the other way round. The five major Indian-specific sub-clusters of haplogroup M are not represented to any significant extent elsewhere in Asia. Thus, it appears that although Indian populations display haplogroup M frequency similar to or even higher than that in other Asian populations, the internal structure of haplogroup M lineages in India reflects their basically autochthonous development.

Indian caste populations harbor only about 4% of such East Asian-specific mtDNAs, compared to 17% of the West Eurasian ones. This proportion of East Asian mtDNA increases as one travels eastward till Bangladesh where the frequencies of haplogroups common in eastern Eurasia are observed in up to 17 per cent. Surprisingly, the populations of Indian held Kashmir exhibit these frequency as an average of about 21 per cent. This anomaly may be explained by admixture with the adjacent populations from Tibet. Similarly, the high frequencies of East Eurasian-specific mtDNAs found in the southern Indian state of Tamil Nadu (21%) are unexpected when considering their relatively low frequencies (~1%) in West Bengal and Andhra Pradesh. The typically eastern Asian haplogroups A, B and F, are practically absent in India, although B and F are very common in neighboring southeastern populations of Asia.

Although the data about East Asian populations are still far from being representative, it is already apparent that the structure of East Asian mtDNA phylogeny is different from that of European and African populations. A common feature for all the East Asian populations studied so far is that the major fraction of their mtDNA pool is made up of haplogroups A, B, F and M. Haplogroup M is a dominant mtDNA cluster among the populations of dominant mtDNA cluster among the populations of 73,000 years could indicate the time of the initial colonization of Asia by modern humans.

Peopling of India: Archaeological evidence advocates the colonization of India by modern humans, using Middle Palaeolithic tools, during the Late Pleistocene (69,70,71). The large number of deep-rooting, Indian-specific mtDNA lineages of macro haplogroups M and N, whose presence cannot be explained by a recent introduction from neighboring regions, is consistent with the archaeological

data (55). These two lines of evidence suggest that the initial settlement, followed by local differentiation, has left a predominantly Late Pleistocene genetic signature in the maternal heritage of India (72,71,60,73,74). The initial settlement of South Asia, between 40,000 and 70,000 years ago, was most likely over the southern route from Africa because haplogroup M, which is the most frequent mtDNA component in India, is virtually absent in the Near East and Southwest Asia.

The initial split between West and East Eurasian mtDNAs is postulated between the Indus Valley and Southwest Asia. The Narbada Valley seems to constitute the maturation or expansion zones where, after the initial (coastal) peopling of the continent, local branches of the mtDNA tree arose (ca. 40,000 – 60,000 years ago), and from where they where further carried into the interior of the continent. Admixture between the expansion zones has been surprisingly limited ever since.

Recent Immigrations and Genetic Admixture: India has experienced immigration of several populations in the past, further adding to the complexities of Indian population structure. Among the most celebrated migrants are the Hardpans at the end of the Indus Civilization, followed by, about 1,000 years later, by the so-called Aryans or Aryanized Indus people. Although no specific traces of these gene flows have so far been detected, detectable recent gene flow from west Eurasia has been shown by many studies, some prior to the Aryan invasion (111,112) . Recent gene flows are difficult to be discerned from the old and because of this the matter can probably unsolvable at the present time.

Another well-researched recent migration is that of the Siddi people. The Siddis are mainly found in three Indian states - Gujarat, Karnataka and Andhra Pradesh and have typical African features such as dark skin, curly hair, broad nose, and so on. Historically, it is known that they were brought to India by Portuguese traders between the 17th and 19th centuries and sold to the Nawabs and the Sultans of India to serve as soldiers and slaves. Thangaraj et al (113) showed the presence of a Y-chromosome *Alu* insertion; an African-specific marker, in 40% of Siddis. The mitochondrial DNA hypervariable sequence also confirmed the Siddis' affinity with Africans. However, there is no high resolution study pertaining to the origin, affinity and genetic structure of the Indian Siddis (114,115,116). Shah et al (117)) showed that the Siddi population has a combined ancestry (that is, 70% African and 30% Indian and European).They further estimated that the Siddis have admixed with the neighbouring Indian populations for about 200 years ago (eight generations). Their genetic finding coincides with the historical record of the arrival of Siddi people in India (117). Further, extensive investigation on YSTRs revealed that the Siddis are the direct descendants of the Bantu-speakers of sub-Saharan Africa. Researchers observed an Indian-specific gene pool in Siddis but the Siddi-specific gene pool was not observed in neighboring Indian populations. This firmly suggests the unidirectional gene flow from the Indian population to the Siddis, confirming the rigidity of the Indian social structure (117).

Other well-documented recent migrations are those of the Muslim populations. The Arab Muslims established their first colony by conquering Sindh in 711 AD. During the 13th century, a Turkic kingdom was established in Delhi and in the 16th century the famous Mughal Empire appeared in India. The Muslim immigrations were especially male-mediated in the form of invaders from Iran and Khorasan and later from Central Asia. Several studies have tried to trace their genetic structure in comparison with the local non-Muslim population groups but they failed to reveal any difference.The genetic analysis of Indian Muslims shows the spread of Muslims in India was mainly mediated by cultural adaptation linked with minor gene flow from Central Asia or Iran.

The most recent migration to India has been in 1947 when a large number of Sikhs and Hindus from the Pushtun country and West Punjab to Indian Punjab, Haryana and western Utter Pradesh. Obviously, they carried their largely western genes with them and donated the respective populations where they resettled. A sizable population from Baluchistan and Sindh also migrated to Gujarat and southern Rajasthan, with consequent genetic influences on the host populations.

Emergence of Castes in India and Waves of Migration: A tentative view can be put forward on the development and maintenance of the caste system on the basis of genetic observations.The ancestral tribes might have given birth to various subtribes over time. Some of the subtribes might have migrated and gradually established themselves as lower caste groups through better knowledge of procuring necessary resources. Further, the empowerments of some of the lower caste group might have helped them to establish themselves as middle caste groups. Increased mastery over technological and economic measures among some of the middle caste group might have facilitated attainment of the upper caste level, thus giving rise to a complete caste system. Hence, a person’s profession became the symbol of the caste to which he or she belonged. As time passed, the caste system might have fortified itself in society by dividing populations into several endogamous pockets, and has undoubtedly played an essential role in shaping present day Indian genetic architecture. Furthermore, India has witnessed several waves of immigrations. The immigrants were absorbed into different hierarchal levels of the caste system.

A Two-Pronged Ancestry: A recent paper, authored by Priya Moorjani, David Reich, and their colleagues has made a big splash on the Internet. A key finding, reported by Reich is that most Indians today are descendants of two major population groups Ancestral North Indians (ANI), who probably migrated into the subcontinent 8000 or more years ago from the Middle East, Central Asia, and Europe; and Ancestral South Indians (ASI), who were native to the region and had been there much longer. The study also showed that these two groups began to mix at some point in the past, although just when was not clear.

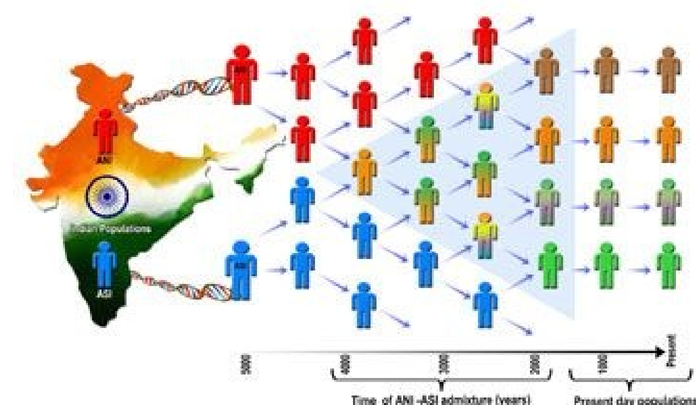


Fig. 7. Mix and then match. Ancient Indians from the north (ANI) and south (ASI) of India first intermarried widely and then began sticking to their own groups (118)

Theresults,reportedin *The American Journal of Human Genetics* (118) , paint a complex picture: Beginning about 4200 years ago, ANI and ASI populations, which previously had kept mostly separate, began mating together, a flury of marriage that probably lasted more than 2 millennia. Then, beginning about 1900 years ago or somewhat later, mating patterns shifted dramatically. Local populations became entrenched, eschewing intermarriage with other groups and adopting a cultural pattern of what researchers call endogamy, the practice of marrying only within an ethnic or social

group. “There was a major demographic transformation in India from a region where mixture was pervasive to one in which it is very rare because of a shift to endogamy,” says lead author Priya Moorjani.

According to the authors, the traces of this alternating pattern can be clearly seen in the genomes of modern Indians today. For example, the percentage of ANI ancestry ranges from a high of 71% in the Pathan ethnic group of northern India to a low of 17% in the Paniya group of southwest India, meaning that the degree of ancient admixture is still measurable and significant in even the most isolated and endogamous ethnic groups. “The most remarkable aspect of the ANI-ASI mixture is how pervasive it was, in the sense that it has left its mark on nearly every group in India,” Moorjani and her co-workers write.

What accounts for this pattern? The team points out that the period of intermarriage overlaps with a time of huge social upheavals in India, including the collapse of the Indus civilization with largescale population movements and the rise of the Vedic religion. But after 1900 years ago, India’s caste system became a major cultural force, the team concludes, based on its new genetic findings and confirmed by evidence from ancient religious texts. This conclusion, however, does not correspond with the Indus history: It was after 2000 that the Indus people started moving to the Indo-Gangetic Divide, this migration accelerating in the beginning of the first millennium BC when the so-called Aryans and the Aryanized Indus tribes struggled to establish the first early kingdoms in the region. Thus, the time of social and economic upheavals was not before 1900 BC but afterwards.

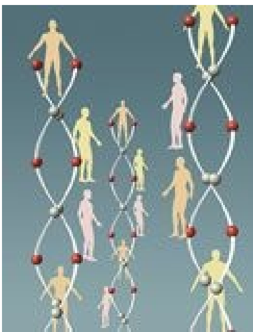
One wonders, what is the historical or archaeological basis for a hefty migration of western people in or around 8000 BC? There is none. And how do we define the ANI and ASI and how do we differentiate one from the other, that is, what is the scientific basis for such a classification? It is true that the northern population groups had more western genetic material than the southern population groups but this effect was only relative not fundamental. Moreover, the relatively more western genes in the northern populations was because of their closeness to the human interaction node that connected the Gangetic plains with the Indus plains, the carriers of the western genetic material.

Admixture analysis cannot distinguish between recent and ancient gene flow or directionality of flow. In addition, inferences based on basal haplogroup frequencies alone and limited geographic sampling can be misleading and potentially incorrect. This shortcoming is especially magnified when coupled with inadequately resolved haplogroup structure and small sample sizes. In haplogroups R1a1 and R2, the associated mean microsatellite variance is highest in tribes, not castes. This is a clear contradiction of what would be expected from an explanation involving a model of recent occasional admixture. Beyond taking advantage of highly resolved phylogenetic hierarchy as just an efficient genotyping convenience, a comprehensive approach that leverages the phylogeography of Y-chromosome diversification by using a combination of haplogroup diversification with geography and expansion-time estimates provides a more insightful and accurate perspective to the complex human history of South Asia. The data regarding haplogroup L are particularly instructive in this regard.

Summary: The results of genetic research tell us that modern humans arrived in this region a long time before the dates which fossil evidence has been able to prove so far, probably around 60,000 or even 70,000 years ago. Three Indianspecific haplogroups, M2, U2i and R5, which encompass about 15% of the Indian mtDNA pool, exhibit deep coalescence ages of about 50,000 – 70,000 years. Thus,

their spread can be associated with the initial peopling of South Asia.
The research results also show that a successive inflow of other peoples, with their own genetic markings, languages, and cultures, has occurred since then and have left their genetic legacy in the present populations. Occasionally, early Indian populations also expanded to the borderlands whenever the ecology of the region allowed it to happen. For example, there is a strong genetic evidence for ancient human migrations from Gujarat into adjoining Sindh in Pakistan and a trickle of human inflow from north India into northern Punjab. Similar migrations and gene flows also took place in the reverse direction to infuse the Indian populations with the 'western' genetic material. The traces of these admixtures are still evident in populations on both sides of the Indo-Pak border.

IV.4. Genetic Footprints of the Indus Man



The previous two chapters of this Section have shown how the discipline of archaeogenetics has been able to shed some useful light on the population history of West and South Asia and in so doing has provided us with some meaningful indicators that we can employ to examine the population history of Pakistan. In this chapter we shall

try to consolidate some of this information and see if we can aluminate the genetic outlines of Pakistan's populations. We shall also review a few Pakistanspecific investigations in some details. Some of these data touch upon the ethnic diversity of Pakistani populations and we shall examine them in brief.

Pakistan is well-known for its human and geographical diversities. It has a variety of landscapes ranging from desert to evergreen forest, fertile plains to dry plateaus, and lowlands to the high Himalayas. They all give refuge to diverse populations of humans, plants, animals and microbes. Pakistan also has an extensive river system, i.e. The Indus and its tributaries, that feed the fertile plains of Punjab and Sindh and provide adequate food for the country. There are a large number of anthropologically well-defined human populations, which sometimes appear as linguistic groups. A few racial groups, such as the Shiddi of Makran and Karachi and the Hazaras from the Quetta Valley, even have distinguished appearance compared to the majority. The size of these populations ranges from a few thousands to several millions. In effect, Pakistani the current Pakistani population is a mosaic of a number of distinct ethnic and linguistic groups.

Genetic Studies: There has been a healthy tremendous interest among historians, archaeologists, anthropologists, linguists and geneticists to understand the unique structure of Pakistani populations and their affinities with the rest of the world and a truly large number of genetic studies on South Asian populations have been conducted in the last 20 years. Unfortunately, most of the studies cover a limited number of genetic systems, and only a few provide appropriate information on the genetic diversity and differentiation of population structure of this region. There seems to be an inordinately high interest in India and abroad in the question of the origins of 'caste' and 'tribal' groups and the extent to which these two population groups differentiate. Despite reports suggesting that genetic affinity does not show any large degree of congruence with sociocultural hierarchy and linguistic groupings, study after study keep on coming reflecting a deep interest of Indian scholars in the issue of castes and tribals. In this process, the relationship of geographic proximity, topographic hurdles in human contacts, ethnohistory, population migration and isolation, and biosocial and cultural affiliation get ignored. The obsession with the Aryan question among prehistorians of India is another unfortunate skewer in determining the direction of research.

The situation in Pakistan is no different. First of all, the number of meaningful studies has been

regrettably small. Secondly, whatever has been published is concerned with such mundane questions as the possible contribution of the Greek and Mongol armies to the genetic make up of Pakistani populations. While such minuscule but esoteric population groups, as the Kalash and the Parsis have been studied extensively, and while such relatively small groups as Brushuski, find frequent mention in literature, no comprehensive study is yet available that addresses the genetic composition of the larger part of Pakistani population from the standpoint of their diversity and age. While the important question of the antiquity of the so-called Makrani population on the coast of Baluchistan and Sindh has not been resolved, the genetic impact of a much larger group, the Muhajirs, on the Sindhi population is completely ignored. Similarly, the genetic contribution from the West (Iran and Central Asia) is eagerly followed but that from the East (India) is taken for granted. It is only in recent years that a systematic study of these issues have begun to get some attention. All these studies, however, been done on *ad hock* basis.

In spite of all this, interesting insights into population diversity and interaction between the populations of Pakistan and those of the surrounding region have begun to emerge. The data generally collected and analyzed by Human Genome Project and some independent academic research are contributing to this databank from which a better understanding of the population dynamics in the ancient history of Pakistan is expected to emerge. Because the genetic studies over the geographical space of Pakistan are somewhat patchy and the number of these studies is rather small, the conclusion drawn from the available data is necessarily tentative. It is, therefore, necessary that we gather as much information as we can from the studies done in India, Central Asia, and the West (including Iran) and try to connect these dots with those seen within Pakistan. These studies have been reviewed in the foregoing two chapters and we shall make here frequent reference to them.

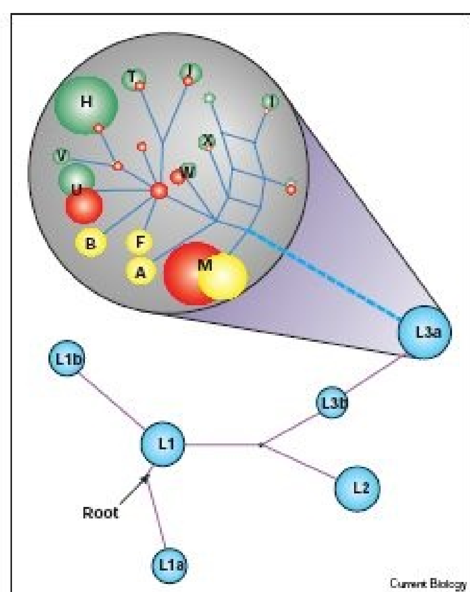
The first comprehensive analysis and synthetic inferences based on allele frequencies of classical genetic markers (blood groups, serum proteins, and red-cell enzymes) in various populations of South Asia, were conducted by Cavalli-Sfroza et al (46) who drew their data from a large number of earlier publications of various researchers. On the basis of their analyses the authors showed that populations of Pakistan were positioned between those of the ‘West’ (i.e., Iran and Central Asia) and those of the East (i.e., India) This general conclusion was confirmed by later research. Early studies of the ABO blood groups and classical protein markers did not include all groups of population and mostly classified them according to their place of residence. For example, a population tree based on 54 classical enzyme markers places the Hazara and Pashtuns in the West Asian cluster containing the northern Caucasoids (46). In another population tree, based on 47 classical protein polymorpisms, the Pakistani samples formed a small sub-cluster within the Indo-European speakers from India.

Recent studies are more thoughtful and, because they are based on molecular genetics, they are more discriminating. The collected data also have sufficient depth and breadth as to make them a sound foundation for reconstructing a genetic past of most of the population groups in the area. Unfortunately, however, due to limited availability of laboratory infrastructure within Pakistan and India, and for that matter in Iran and Central Asia, for conducting molecular genetic studies, data on genomic polymorphisms from these populations are limited.

There are a few pakistan-specific studies which we shall review in the followings and attempt to draw some general conclusions from them. These studies fall into two basic groups: those based on mtDNA analyses and those which look at Y-chromosome DNA of the current populations. All these are isolated studies but generally study the same population groups. Both mtDNA and Ychromosome

variation in the Indus Valley show a mosaic composition of different components, some derived from West Eurasia, some from India, and some of indigenous origins. The contribution from East Asia and Africa is marginal in the overall composition of the population at large but it stands out quite prominently in two distinct ethnic communities, i.e. the Hazaras and the Makranis, respectively. The patterns of population distribution are generally much more discernible for mtDNA data than for the Y-chromosome. As an overview, mtDNA variation shows a simple west-to-east cline.

Mitochondrial-based Studies: It is known that all of the mtDNAs outside of Africa are derivatives of just two female lineages: M and N, which arose from the African stem L3 (see Fig.1.). Of these subclades, the most deep-rooting ones (coalescence time between 40,000 and 60,000 years) indicate that South Asia has played a pivotal role in the out-of-Africa colonization and dispersal of modern humans (76). It has been found that the ancestral node of the phylogenetic tree of all the mtDNA types typically found in Central Asia, the Middle East, and Europe are also to be found in Pakistan at relatively high frequencies. The inferred divergence of this common ancestral node is estimated to have occurred slightly less than 50,000 years ago. The major maternal lineages, or mtDNA are M, R, and U, whose coalescence times have been approximated to 50,000 BP.



The skeleton network of Indian lineage clusters on the background of continent-specific mtDNA haplogroups. Red, Indians; green, western Eurasians; yellow, eastern Eurasians; blue, Africans. Haplogroup frequencies are proportional to node sizes. All Indian, eastern-Eurasian and western-Eurasian mtDNA lineages coalesce finally to the African node L3a. The former are shown magnified to account for higher mtDNA diversity in sub-Saharan Africans. The most likely root of the tree [15] is indicated within a pan-African cluster L1. The dashed line leading from the African external node L3a to the Eurasian mtDNA varieties identifies the position of L3a in the magnified part of the tree.

Fig.1.The network of Indian-specific lineage clusters on the background of continent-specific haplogroups.

Quintana-Murci et al (53) have investigated the contribution of the region west of Pakistan (Iran, Afghanistan, and Central Asia as well as the Middle East and Anatolia) to the mtDNA diversity in Pakistani populations. They studied the same population groups of Pakistan as those studied by Qamar et al (48) in connection with their Y-chromosome analysis, to be discussed later. There are several studies on the mtDNA variation in the population groups of South Asia as a whole and some of them have been described in the last two chapters. They give us a fairly good idea about the genetic diversity of the region and inform us about the genetic influence on the population of Pakistan from the East and the West.

The role of vast deserts between the Indus basin and the mainland Iran, limiting the gene flow between

these two regions, has already been discussed (Chapter IV.2.). However, despite this physical impediment to the movement of people, some degree of gene flow did occur between Iran and Pakistan.

There is now universal agreement that various Pakistani populations share a common late Pleistocene maternal and paternal ancestry, along with detectable east and west Eurasian ancestries (60). It has been variously shown that the Pakistani populations have two major distinct ancestry components; one restricted to India, the second one restricted to the area West of Pakistan.

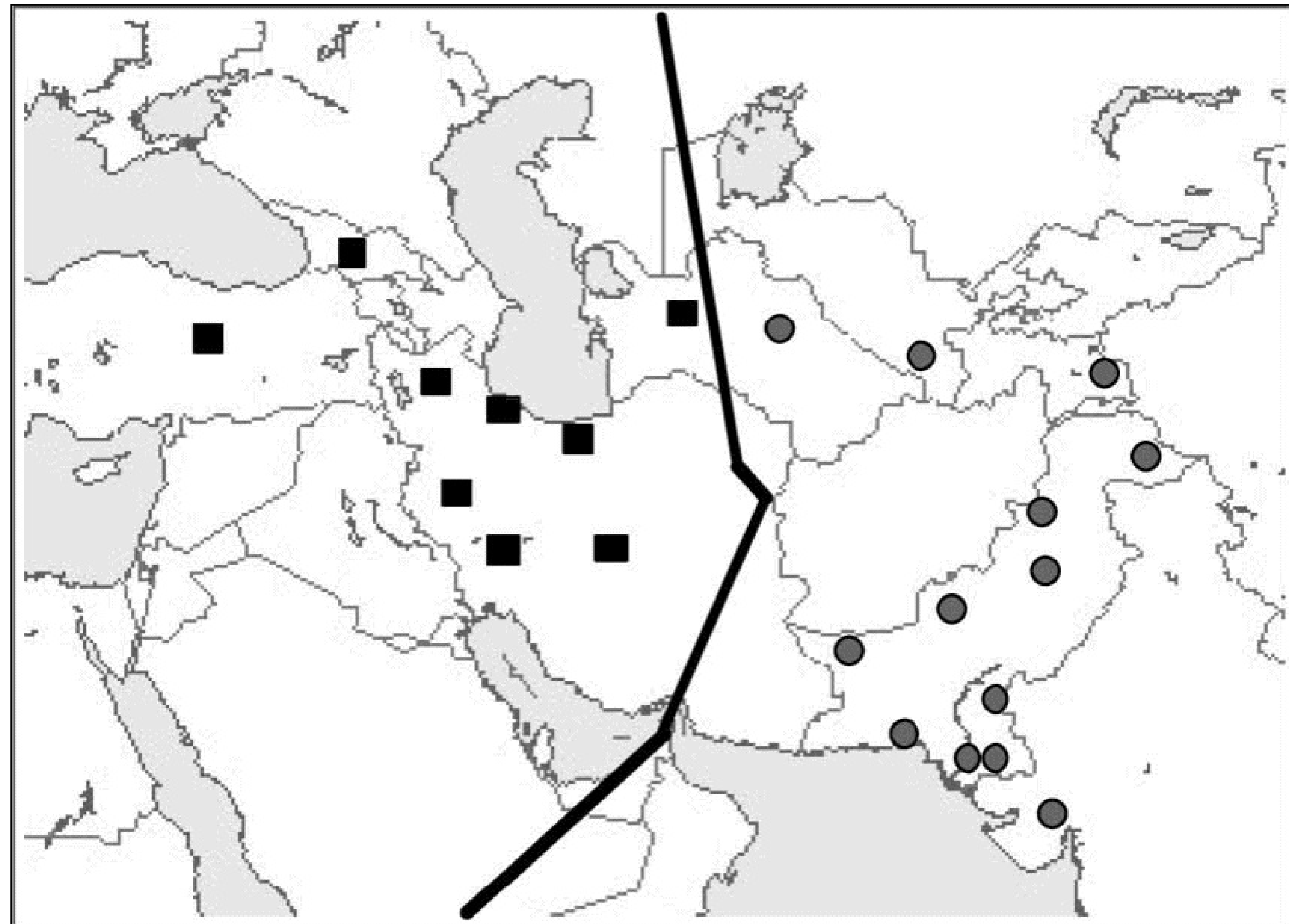


Figure 2. Map showing the groupings and barrier, inferred from SAMOVA analyses when searching for two groups. SAMOVA (spatial analysis of molecular variance) analysis defines groups of populations that are geographically homogeneous and maximally differentiated from each other, and the population symbols represent the groups of populations inferred from the SAMOVA analyses. A strong genetic barrier separating populations west of the Indus Valley from Pakistani populations emerged from the mtDNA data.(78)

There is also a third element, i.e. The Pakistanspecific component, such as haplogroup W. It is noteworthy that both of the ancestry components show higher haplotypic diversity than those predominant in west Eurasia. This suggests an ancient demographic history and/or long-term larger effective population size in Pakistan than that which can be attributed to recent colonization or some

recent admixtures.The East Asian contribution, which is significant in Indian populations, is practically no presence in Pakistan.This is despite the known historical population movements from the East (e.g. Mongols, Altaic-speaking populations, etc.) to this area. The Hazaras are a special case, being a selfcontained community and bearing a strong genetic signature from the East. As will be shown, this is a very recent phenomenon, and like the Muhajirs in southern Sindh or the Makranis in southern Baluchistan, a recent introduction to the general population.

The data from Quintana-Murci (78) shows that the pool of mtDNA lineages found in Pakistan is an amalgam of eastern (Indian) and western Eurasian (Iranian and Central Asian) mtDNA haplogroups of both ancient and young ages. In addition, we find discrete population groups in the north as well as in the south which show additional elements in this admixture. The case of the Hazaras, the Makranis, and the Muhajirs have already been mentioned.

The general population of Pakistan is an admixture of the western and Indian lineages. The proportion of the two vary but, like the Y-lineages discussed below, are divided by the Indus River. To its West, western and central Asian lineages are prominent and to its East the Indian lineages are much more common. Additionally, there seems to be a cline southward: northern areas are more western than the southern areas. Figure 3 depicts the relative contribution of eastern, western, African, and Mongoloid mtDNA to the various population groups in Pakistan as well as in the area to its West.

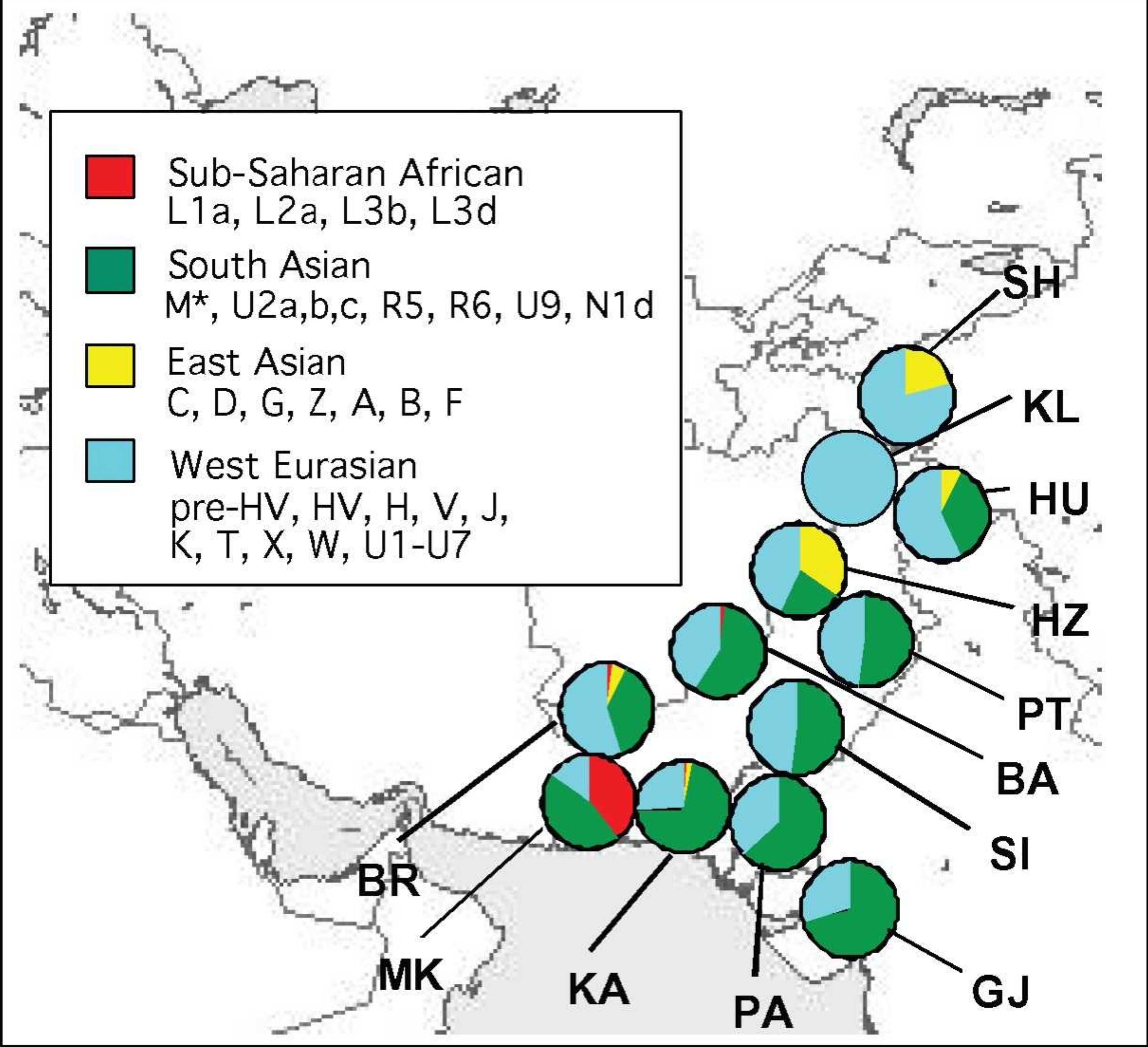


Figure 3. Pakistan's mtDNA phylogeography (77) Population Code: SH:High Pamir; KL:Lalash; HU:Burusho; HZ:Hazara; PT:Pashtun; BA:Baluch; SI: Sindhi; PA:Parsi; KA: Muhajir; GJ: Gujarat.

1) A simple pattern underlies the mtDNA variation in this region: a west-to-east divide with a sharp boundary. Populations located west of the Indus basin, including those from Iran, Anatolia and the Caucasus, exhibit a common mtDNA lineage composition, consisting mainly of western Eurasian lineages, with a very limited contribution from South Asia and eastern Eurasia.

2) Within Pakistan, the populations on the west side of the Indus are genetically different from those on the eastern side. Those on the western side are more 'western' and those on the eastern side are more 'Indian'.

3) There is a north-south gradient in the proportion of Indian-specifiuc mtDNA component, southern region having more than the northern region.

4) The Mongoloid component is not widespread or diffused, it is concentrated in a specific area (where the Hazara population live). This population group shares this mtDNA with certain populations in Central Asia.

strated to be a complex mtDNA lineage cluster with an estimated age of **Table.1. Pakistani Ethnic Groups Studied by Qamar et al (48)** 51,000–67,000 years. Kivisild and coworkers (72) have found that haplogroup U is the second most frequent haplogroup in South Asia as it is in Europe. There are indications that most of the extant mtDNA boundaries were likely shaped by anatomically modern humans during the initial settlement of Pakistan, along with India, ca. 50,000-70,000 years ago (77).

U7 is another subclass that needs to be mentioned. This is a local lineage in the Indus Valley; it shows signals of *in situ* differentiation and appears to be limited to this region. U7 lineto be limited to this region. U7 line 52,000 years ago), similar to haplogroup M* in the region (77,72,57). The distribution and age of this lineage suggest that it is the legacy of the first inhabitants of the southwestern Asian region which underwent important expansions during

Table 1

Pakistani Ethnic Groups Studied

Ethnic Group	Location[a]	Language Family	Census Size[b]	Suggested Origin(s)
Baluch	Baluchistan	Indo-European	4,000,000	Syria: Aleppo (Quddus 1990)
Balti	Eastern Baltistan	Sino-Tibetan	300,000	Tibet (Backstrom 1992)
Brahui	Baluchistan: Kalat State, Sarawan and Jhalawan regions	Dravidian	1,500,000	West Asia (Hughes-Buller 1991)
Burusho	Karakorum Mountains: Hunza, Nagar, and Yasin	Language isolate	50,000–60,000	Alexander's army (Biddulph 1977)
Hazara	Southern Baluchistan: Quetta and NWFP: Parachinar	Indo-European	NA	Genghis Khan's soldiers (Bellew 1979)
Kalash	NWFP: Hindu Kush Mountains: Bumburet, Rambur, and Birir valleys	Indo-European	3,000–6,000	Greeks (Robertson 1896) or "Tsyam," possibly Syria (Decker 1992)
Kashmiri	Kashmir Valley	Indo-European	NA	Jewish (Ahmad 1952)
Makrani Baluch	Makran coast	Indo-European	NA	West Asia (Hughes-Buller 1991)
Negroid Makrani	Makran coast	Indo-European	NA	Rajput (Quddus 1990); Africa?
Parsi	Karachi	Indo-European	A few thousand	Iran, via India (Nanavutty 1997)
Pathan	NWFP and Baluchistan	Indo-European	17,000,000	Jewish (Ahmad 1952), Greek or Rajput (Bellew 1998; Caroe 1958)
Sindhi	Sindh	Indo-European	15,300,000	Mixed (Burton 1851)

[a] NWFP = North West Frontier Province.
[b] NA = not available

the Paleolithic period. Some West Eurasian lineages are

5) The population of the Kalash stands out from the genetic cluster of Pakistani populations in being devoid of any eastern material and falling purely into the western sphere.

6) Parsee population group shows a definite

mtDNA affinity with the Gujaratis (west India). It is not surprising because most of the resent day Parsees in Karachi recently came from Gujarat. This reading is in variance with that of Y-DNA where the Parsees show a definite affinity with Iran (see below).

7) These Indian- and western-specific line ages are found intermixed with some Pakistan specific lineages, which indicate a local inde pendent development over a very long time pe riod.
present in Pakistani populations at high frequencies (26–57%), with a sharply decreasing gradient towards India (78). Conversely, Quintana-Murci et al (53) tell us that populations located west of the Indus basin exhibit a common mtDNA lineage composition, consisting mainly of western Eurasian lineages, with very limited contribution from India (Fig.2.). As stated in Chapter IV.3., some of these India-specific mtDNA lineages are ancient and are of probable Pleistocene origin.

Y-Chromosome Evidence: Y chromosome DNA provides a unique source of genetic evidence as it carries the largest non-recombining segment in the genome and contains numerous stable binary markers, including base substitutions, which can be used in combination with more rapidly evolving

8) Various demographic analyses reveal at least two major expansion phases that have in fluenced the wide assortment of the Pakistani mtDNA lineages. Geographically the zone of ad mixture of West and South Asian maternal linea ges spans all over the country (53,60).
markers, such as microsatellites (82). Consequently, the uniparentally inherited non-recombining Y chromosome is a widely used marker for assessing the origins of populations along the paternal descent line (83). Most Pakistani communities trace their origin along their male ancestry and in this re

All Pakistani populations have a substantial portion, although in varying proportions, their maternal roots in haplogroup M; a, Indian-specific lineage. It has been suggested that haplogroup M was brought to South Asia by the earliest migration wave of anatomically modern humans from Africa, *ca*. 60,000 years ago (75,80,59). This means that the roots of the current Pakistani population can be traced to more than 60,000 years ago. Another evidence for a continued, deep rooted ancestry of a Pkistani populations comes from the study of mtDNA haplogroup U, which has been demonspect Y chromosome DNA studies have received much more attention than those based on mtDNA analyses. Based on these studies very detailed Y phylogenies have been constructed that allow malespecific aspects of genetic history to be investigated.

A group of Pakistani scientists, working at European research institutions, have investigated Y lineages of several population groups of Pakistan (84,85,87--91). This work, limited as it may be, shed some valuable light on the origins and genetic history of the subgroups that make up the Pakistani population. Mohayudin et al, (89) studied 71 males from 12 populations and found a high

level of genetic diversity in almost all of these individuals. For example 446 haplotypes occurred in one single individual but only 19 haplotypes were present in more than three males. They also cite two striking examples of haplotype sharing; one involving 13 individuals, and the other 17. The 13 individuals were all Parsees, and 16 of the 17 were Brohis, providing evidence for strong population substructuring. In 1991, Qamar et al (90) surveyed 9 Pakistani subpopulations for variation on the nonrecombining portion of the Y chromosome. In another comprehensive study (48), they studied 12 ethnic groups (Table 1) and compared the results with the common myths about their ancestries**.**

In striking contrast to the mtDNA data, there is no strong evidence in Pakistani populations of Ychromosome signatures of the early inhabitants of the region following the African exodus (48,49), with their Y-chromosomes largely replaced by subsequent migrations or gene flow. The Y-chromosome gene pool of Pakistani population lineages generally relates to western gene pool, particularly from the Middle East (48). Conversely, few traces of East Asian haplogroups are observed in the Indus Valley populations.

Figure 4 represents the distribution of four representative Y haplogroups in Pakistani populations. The distribution of these haplogroups, despite some notable linguistic differences and with the exception of the Hazaras, are strikingly similar to one another. Indeed, the language isolate-speaking Burusho, the Dravidian-speaking (?) Brohi, and the Sino-Tibetan–speaking Baltis do not stand out from the other populations in the haplogroup analyses, suggesting either that the linguistic differences arose after the common Y pattern was established or that there has been sufficient Y gene flow between populations to eliminate any initial differences. It is estimated that between 4,000 and 13,000 years ago, the Pakistani populations have experienced considerable male gene flow between themselves or from a common source. This is the time period when the Neolithic culture was spreading throughout the Indus Valley.

Qamar et al (48) compared the Pakistani population groups with the rest of the world by using a comparable data from Hammer et al (92) and conducting a Principal Component Analysis. Additionally, they employed their data to compare the various Pakistani population groups under study with each other. These comparisons, in the form of Principal Component Diagram, are represented by the Figure 5. The figure shows that most of the Pakistani populations appear to be clustering around a pooled ‘South Asian’ sample. This is not surprising because the South Asian sample included about 32% of Pakistanis in the total individuals tested. The data, therefore, amounts the comparisons of Pakistani population partly with itself and does not distinguish Pakistani populations from the rest of South Asia.

The PC diagram also shows that the 12 population groups studied by Qamar et al, have strong genetic affinity with Northern African, Central Asian and European populations but not much with East and North Asia and Oceania. The greater ge

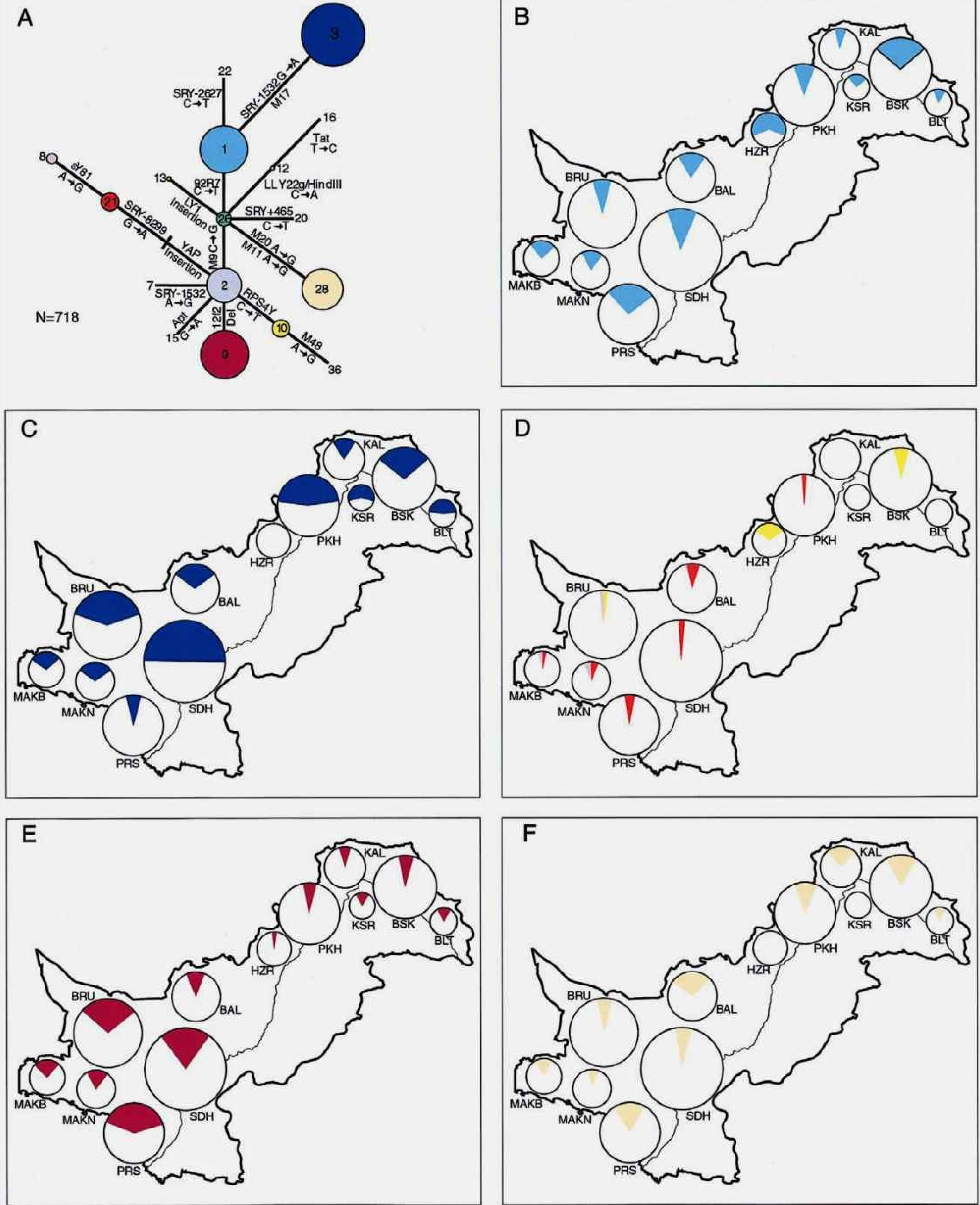


Figure 4. Distribution of Y haplogroups in Pakistan. ***A*****, Unrooted maximum-parsimony tree**

showing Y haplogroups (*numbers in circles*) and mutations (*on lines*). Circle area is proportional to frequency in Pakistan. *B–F,* Frequencies of Y haplogroups in populations sampled. Circles represent populations and are placed in the approximate geographical location sampled; area is proportionate to sample size.
See Table 2 for population code. (48)

netic similarity of Pakistani populations to those in the West is illustrated by the fact that four of the five frequent haplogroups in Pakistan are also frequent in western Asia and Europe but not in India and further east. Conversely, the haplogroups that are frequent in East Asia are rare or absent in Pakistan, which, according to some estimates, started around 20,000-30,000 years ago, seems to correspond to the transition from the Middle to the Upper Paleolithic. There has also been a substantial gene flow in historical times to northern as well as southern Pakistan and these are expected to have consider

A

0.6
0.4
0.2
0
-0.2
-0.4
-0.6

PC2 (25.6%)

Oceania
East Asia
Sub-Saharan Africa
North Asia
North Africa
KAL
BAL
Middle East
PRS
Central Asia
South Asia
MAKB
PKH
BSK
Europe
HZR
BRU
BLT
MAKN
America
SDH
KSR

-0.4 -0.2 0 0.2 0.4 0.6 0.8

PC 1 (32.2%)

B

0.6
0.4
0.2
0
-0.2
-0.4
-0.6

PC 2 (23.3%)

KAL
MAKN
PRS
BAL
BRU
BSK
PKH
BLT
HZR
SDH
MAKB
KSR

-0.4 -0.2 0 0.2 0.4 0.6 0.8

PC 1(52.0%)

able influence on the genetic make-up of Pakistani population groups. These influences have been identified by some studies but denied by others. No comprehensive study is, however, available.
A widely known scenario is an invasion of nomadic Indo-European tribes around 3,000-4,000 years ago either from the West or from the Central Asian steppes in the Northwest. Another frequently talked about hypothesis is based on the assumption that some 7,000-8,000 years ago several varieties of wheat and other cereals reached Pakistan from outside and that these were carried by some Neolithic farmers from the Fertile Crescent. This hypothesis is supported by an European parallelism where agriculture has been shown to be introduced by the Neolithic farmers from the Levant. In this context, various linguistic arguments are also offered. For example, in parallel with the situation in Europe, it is suggested that the Neolithic farmers from the West not only brought agriculture and animal domestication with them to Pakistan but also a language - proto-Elamite - which was probably a precursor of proto-Dravidic languages (93). Of course, these newcomers brought their genes with them through which they fertilized the Indus Valley. These hypotheses leave the question of the contribution of the newcomers to

Figure 5. Principal-components diagram of Y haplogroup frequencies. *A*, World data using 13 markers. *B*, Pakistani data using 18 markers. World data are shown as squares. Within

Pakistan, Indo-European speakers are indicated by blackened triangles, Sino-Tibetan speakers by an unblackened triangle, Dravid

forming only 2.5% of the total (48). Thus, In terms of their Y-chromosome, the populations of Pakistan are of more western Eurasian (Caucasoid) origin, including a variant which has developed in this area and found at lesser frequency elsewhere.

Recent Gene Flow: One major issue in the study of population genetics in Pakistan is the question of recent "intrusive" genetic material. This phase,

Table 2. Pakistani Ethnic Groups under Study

Population Group Code !! Baluch! ! ! BAL! ! Balti! ! ! BLT! ! Brohi! ! ! BRU ! ! Burusho ! ! BSK! ! Hazara! ! ! HZR! ! Kalash! ! ! KAL! ! Kashmiri! ! KSR! ! Makrani!Baluch!! MAKB ! Makrani Negroid ! MAKN ! Pashtun!
Parsi! !
Sindhi! !
! PKH! ! ! PRS! ! ! SDH ! ! Location_________ Baluchistan, Pak. Baltistan, Pak.
Baluchistan, Pak. Northern Pakistan North-West Pak. Chitral, NW. Pak. Kashmir, aPk.
S. Baluchistan
Makran, Bluch.
Pakhtunkhaw, Pak. Karachi, Pak.
Sindh, Pak.
the gene pool of the contemporary populations begging for an answer. Did the enwcomers largely replace the deep-rooted genetic markers in Pakistani population groups, or alternatively, was the result of recent migrations genetically insignificant while perhaps still profound culturally? The answer is: neither! While the migrations to the Indus Valley have been a common occurrence during the entire prehistory of Pakistan, there is no evidence that a large scale migration of an Indo-European people ever took place or that any profound cultural change in the Indus Valley did ever

happened because of such perceived migration.

Similarly, there is no evidence whatsoever for any migration of Neolithic farmers from the Fertile Crescent into Baluchistan at the eve of the agricultural revolution in the Indus Valley. Although these views are still echoed in some circles, both of these views are now considered too Eurocentric and too simplistic, without any archaeological or genetic foundations. The invasion or migration of 'Indo-Aryans' to the Indus Valley now seems to be a remote possibility and the beginning of agriculture and animal domestication seems more and more a domestic phenomenon in parallel with that in the Fertile Crescent and Western Iran.

While the migration of an Indo-European people or a series of migrations of some seedbearing farmers from the Fertile Crescent is denied altogether, several prehistoric and historic migrations is a matter of historic reality. These post-Stone Age migrations, some from the East but mostly from the West, have left discernible traces of their genes in the present populations (72,,67). Palanichamy's analysis (86) of the complete sequence variation supports the recent entry of those typical western haplogroups, at least for those haplogroups that have been widely sampled in western Eurasia, such as H, V, K, U5, J, and T. The entry time for members of these haplogroups is bounded by less than 11,500 years ago. The minor share of lineages nested in other haplogroups, such as in TJ (1.7%), U5 (0.20%), U4 (0.16%), and K (1.3%), likely relate primarily to migrations during the Holocene period, while the exact source and timing of such migrations (either due to the Bronze Age people, or any later migrations, including Huns, Moghuls, Greeks, etc.), is difficult to establish. Moreover, the Islamization of Pakistan during the Arab rule in the 8th and 9th centuries and the Central Asian onslaught during the 10th and 11th centuries did not introduce significant genetic contribution to the Pakistani gene pool (67). Notwithstanding these reservations, no one can deny a continuous stream of western genes coming into the Indus Valley in historical as well as prehistorical times. These inroads, while small in each case, should have produced a large cumulative effect of the gene pool of Pakistani population.

A Throwback from the Pamir Knot: The spread of Y-chromosome L-M20 must be mentioned here as a special and noteworthy case of a recent gene flow from Central Asia. As described by Oppenheimer (36) and Wells (81) the L-M20 lineage was an offshoot of an eastward migration to Central Asia of lineage M9 from the Near East, which was itself an offshoot of the lineage M89, probably emanating from the Near East refugia, described in Section III. The M9 stock most likely came directly from the 'maturation area' around the Persian Gulf instead of the indirect way through the Levant. Whatever be the case, the L-M20 migration toward Pakistan seems to have originated in the general area

Table 3. Admixture Estimates (48)

Admixture Estimates

Pakistani and Source Populations	Long's WLS	Admixture Estimate	
		mR	mρ
Baluch:			
Syria[a]	−.08	−.1	0
Pakistan	1.08	1.1	1
Balti:			
Tibet[b]	−.06	−.11	0
Pakistan	1.06	1.11	1
Burusho:			
Greece[c]	−.29	−.22	0
Pakistan	1.29	1.22	1
Hazara:			
Mongolia[b]	.67	.52	.41
Pakistan	.33	.48	.59
Kalash:			
Greece[c]	.4	.32	.23
Pakistan	.6	.68	.77
Kashmiri:			
Jews[a]	−.46	−.36	0
Pakistan	1.46	1.36	1
Negroid Makrani:			
Sub-Saharan Africa[b]	.12	.12	.13
Pakistan	.88	.88	.88
Pathan:			
Greece[c]	−.03	−.16	0
Pakistan	1.03	1.16	1
Jews[a]	−.22	−.55	0
Pakistan	1.22	1.55	1
Parsis:			
Iran[d]	1.21	1.06	1
Pakistan	−.21	−.06	0

commonly known as the Pamir Knot. The Pamir Mountains are located in formed by the junction or Shan, Karakoram, Kunlun, and Hindu Kush ranges. They are among the world's highest mountains. The Pamir region is centered in the Tajikistani region of Gorno-Badakhshan. Parts of the Pamir also lie in the countries of Kyrgyzstan, Afghanistan, and Pakistan. South of Gorno-Badakhshan, the Wakhan Corridor runs through the Pamir region, which also includes the northern extremes of the North-West Frontier Province and the northern extremes of the Northern Areas of Pakistan. This area was ostensibly populated during the northward migration from the 'maturation' area around the Persian Gulf,

Central Asia and are knot of the Tian noted in Chapter III.1., and the eastward migration from the Levant.

Y chromosome haplogroup L-M20 has a high mean frequency of 14% in Pakistan and so differs from all other haplogroups in its frequency distribution. L-M20 is also observed, although at lower frequencies, in neighboring countries, such as India, Tajikistan, Uzbekistan and Russia. Both the frequency distribution and estimated expansion time (7000 years ago) of this lineage suggest that its spread in the Indus Valley may be associated with the expansion of local farming groups during the Neolithic period 48) and it does not have anything to do with a similar migration from North to South during the height of the last glacial period *ca.* 25,000 years ago, mentioned in Chapter III.3. Another explanation of the spread of L-M20 in Pakistan is that it may not be a recent haplogroup emanating in the Pamir Knot. Instead, it may be an ancient lineage originating in the Indus Delta from where it dispersed along the western banks of the Indus all the way to the Hindu Kush, as hypothesized by

Field, Petraglia, and Lahr (79) and discussed in Chapter III.3. Thus, instead of traveling southward, L-M20 lineage may have traveled northward. This lineage is most prominent in eastern Baluchistan, the Derajaat, and the Peshawar Valley. Thus, the scenario of its origin being in the Indus Delta and its dispersal through the western length of the Indus Valley is quite possible.

Genetic Diversity and Admixture Estimates: Pakistani population is extremely diverse. The number of polymorphism in Pakistan's populations is as large as that of Africa. That is, there is simply far more genetic variation in this area than anywhere else in Eurasia. This genetic diversity in Pakistani population, along with that of the area to its East and the West, infer that modern human dispersed quite rapidly throughout Pakistan and that this early population apparently remained stable for a long period, fully contributing its genetic material to the present-day populations in the region. Additionally, and somewhat surprisingly, the genetic diversity of Pakistani populations, somehow does not reflect the more recent gene flow from the west or from the east. This is not withstanding the fact that such a genetic admixtures were indeed a fact of life in this part of the world not only in historic times but also in prehistoric period. Historically, it is known that many groups have entered Pakistan during the last millennia or two, as immigrants or as invaders. They must have contributed their genes to the peoples of this land but the magnitude of the genetic contribution of these migrations to Pakistan and then to the Indian subcontinent (assuming, of course, that one can discern the "old and native" genetic contributions) remains an open question. This anamoly may be the result of the currently used methodology in such investrigations. The picture that has emerged so far is that the basic clustering of genetic lineages is not language although a low number of shared haplotypes indicates that recent gene flow across linguistic borders has some limited validity.

Quitana-Murci et al used HVS-I sequences to gain information on the internal population diversity of some of the population groups of Pakistan and compared them with regional groups in the West. Most of these populations showed similar sequence diversity values, with the Kalash showing the lowest (0.830) and the Indian Gujarati the highest (0.998). The low diversity exhibited by the Kalash population is also evident in the low mean number of pairwise differences (3.857). This is the lowest value of all the populations studied in Pakistan and the borderlands, which otherwise ranged from 4.399 in the Baluchi and the Caucasus populations to 6.633 in the Makrani. All this shows a high level of gene flow, both ancient and more recent, and comparatively recent population admixtures. This also indicates a relative isolation for the Kalash.

Genetic diversity does not tell us much about the origins of population in any specific region. However, we can learn something useful if we could study the level of genetic admixture in a given population group and compare it with the genetic markers of the surrounding populations. The methodology rests on a quantitative assessment of genetic admixture and its comparison with its neighbors or presumed source. For example, to test the possibility that the Baluch Y chromosomes have a Syrian origin, as is sometimes proclaimed, we can ask what proportion of the Baluch Ys are derived from Syria and what proportion are from Pakistan (considered to be the Pakistani sample minus the Baluch). Qamar et all (50) used Y-chromosome data to construct admixture estimates for several population groups in Pakistan. They are presented in Table 3. They used these admixture estimates to critically compare the data for the presumed claim with those deduced from the population in question.

The data presented in Table 3 provides evidence for an external contribution to the Hazaras and the Parsis but not to the other populations. These data are consistent with mtDNA data, discussed above,

as they seem to exclude Kalash and Makranis from this category. It is known that the Kalash is distinctly an ‘outlier’ and the Makranis are definitely derived from recent African gene pool.

The failure to find a Y link with a suggested population of origin does not disprove a historical association, but it does demonstrate that the Y chromosomes derived from such historical events have been lost or replaced. Analyses of mitochondrial DNA and other loci would help to elucidate the population histories and would be particularly interesting in populations like the Negroid Makrani and the Balti, in which there is a contrast between the phenotype and the typical Pakistani Y haplotypes.

Dispersal Routes : Figure 6 depicts a composite picture for the peopling of Eurasia as inferred from the extant mtDNA phylogeny. The bold arrow indicates the possible "coastal" route of colonization of Eurasia by anatomically modern humans *ca.* 60,000–70,000 years ago. This "Southern Coastal Route" is suggested by the phylogeography of mtDNA haplogroup M, the virtual absence of which in the Near East and Southwest Asia undermines the likelihood of the initial colonization of Eurasia taking a route north around the Red Sea. Therefore, the initial split between West and East Eurasian mtDNAs is postulated around the present-day Persian Gulf, which some archaeogenticists have designated as the “maturation’ area of the expanding human population. The map also depicts the terrestrial migration northward within Iran and central Asia along the slopes of mountain ranges where enough fresh water and food could be had. As far as the

dispersal within Pakistan is concerned, the map shows a northward thrust along the western bank of the Indus, reaching all the way to the Hindu Kush. A southward movement from the North, again on the western side of the *Indus V*alley is also shown: this represent the possible movement of lineage L-M20 from the Pamir Knot. Two back-and-forth dispersals are shown with neighboring areas of India, one along the northern corridor and one through the southern corridor.

Mythical Origins and Genetic Evidence: The people of Pakistan have particular fascination about their ‘origin’ and this has given rise to many myths and folkloric speculations. It would be interesting to examine these claims of origin and see if

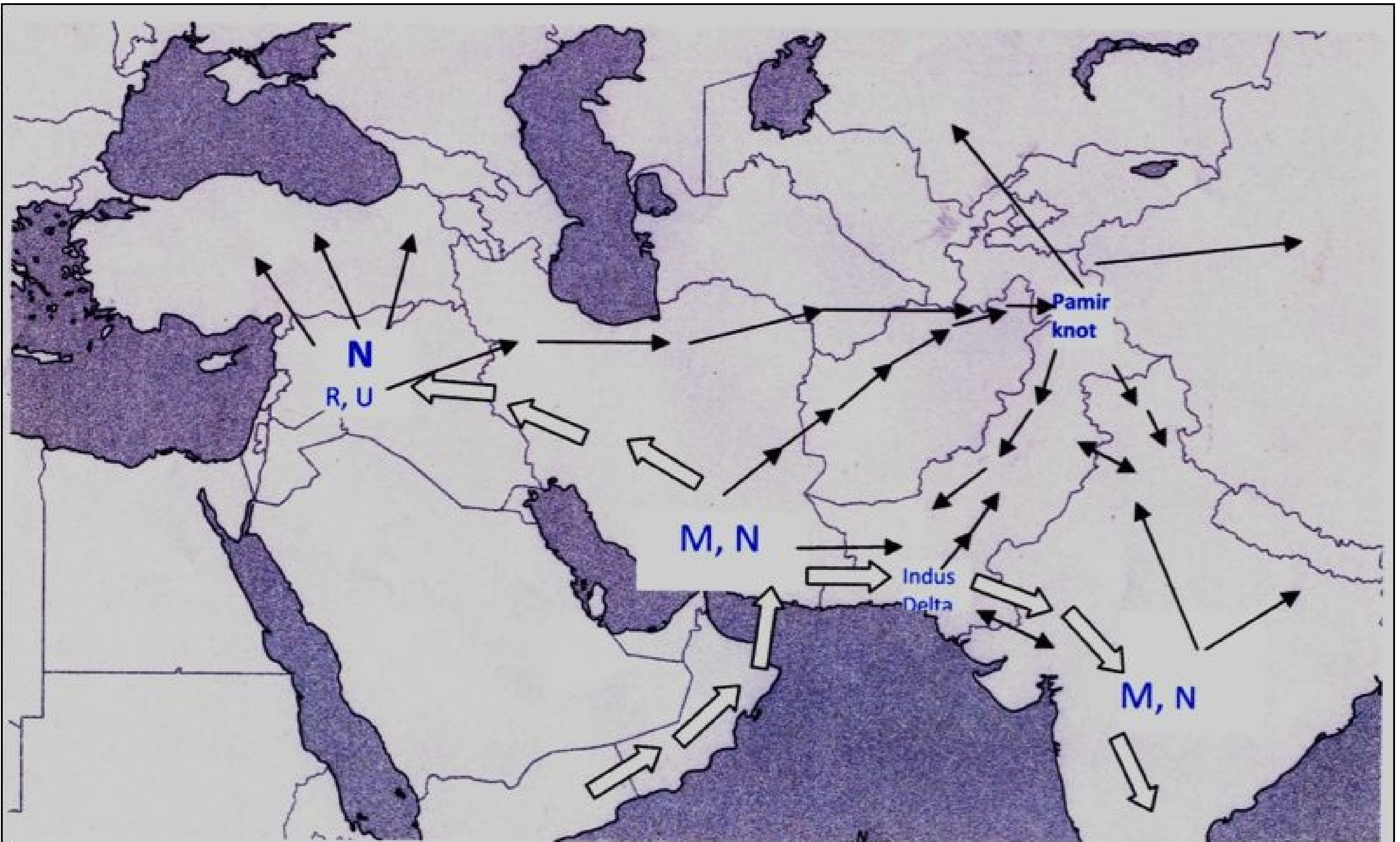


Fig.6. Possible routes of human dispersal in Pakistan. The bold arrows show the main migrational wave, the so-called Southern Coastal Route, the thin arrows show the secondary routes or the inland terrestrial routes. Four routes or expansion waves are to be noted: 1) Throwback from the Pamir Knot (along the western side of the Indus); 2) inland diffusion from the Indus Delta (along the river Indus and its tributaries); 3) a limited penetration into Baluchistan from the 'maturation area' around the Gulf; 4) two-way population exchange with India through the 'northern' and southern' corridors.

any of these have any factual basis as indicated by the genetic make-up of the claimants.

Alexander's Relations: Three populations claim their possible origins from the armies of Alexander the Great: the Burusho, the Kalash, and the Pashtuns. A high frequency haplogroup found in the present-day Greek population is not seen in either the Burusho or the Kalash and was found in only 2% of the Pashtuns. Overall, no support for a Greek origin of their Y chromosomes was found (48,91,78).

The purported Greek connection of the Kalash has become an article of faith in Pakistan and this purported connection has been investigated more than once. In a comprehensive study, Firasat

et al (77) conclude that the Kalash lack typical Greek haplogroups. Qamar et al. (48) also found "no support for a Greek origin" based on their Y chromosomes but somehow continue to look for such a support on the basis of Greek admixture. These estimates of Greek admixture have, however, been dismissed by Kivisild et al. (75). Other researcher, on the basis of Y chromosome allele frequency, describe the Greek contribution to Kalash as 'unclear' (55) or none.
Semitic Connection: Two populations, the Kashmiris and the Pashtuns, lay

claim to a possible semitic origin. Jewish populations show a moderate frequency of haplogroup 21 in a Qamar et all study (e.g., 20%) and a high frequency of haplogroup 9 (e.g., 36%). The frequencies of both of these haplogroups are low

in the Kashmiris and Pashtuns, and haplogroup 28 is present at 13% in the Pashtuns, so no support for a Jewish origin is found.

Ghengis Khan and his Soldiers: The Hazaras is another population group in Pakistan and Afghanistan that has been studied rather extensively. They claim to be the offspring of Ghengis Khan or his soldiers. Quintan-Murci's mtDNA results (77) indicate that the Hazaras are characterized by very high frequencies of eastern Eurasian mtDNAs (35%), which are virtually absent from bordering populations, suggesting that the male descendants of Genghis Khan, or other Mongols, were accompanied by women of East Asian ancestry. A simpler explanation, however, is that this genetic material is a legacy of Mongol's migrations, of which scores have been documented even in historical times, and it may have nothing to do with Genghis Khan, his soldiers, their wives or concubines. This is another example of an unequal sex-specific contribution discussed below in connection with the Makrani population.

Syrian Origin: The suggested origin of the Baluch is in Syria. Syrians, like Iranians, are characterized by a low frequency of haplogroup 3 and a high frequency of haplogroup 9 (9% and 57%, respectively) in Qamar et al's study (48), whereas the corresponding frequencies in the Baluch are 29% and 12%, respectively. This difference and the high frequency of haplogroup 28 in the Baluch (29%) make a predominantly Syrian origin for their Y chromosome unlikely.

West Asian Blood: The Brohis have a possible origin in West Asia (62) and it has been suggested that a spread of a particular Y-chromosome haplogroup was associated with the expansion of Dravidian-speaking farmers (47). Brohis have the highest frequency of haplogroup 9 chromosomes in Pakistan (28%) after the Parsees, providing some support for this hypothesis, but their higher frequency of haplogroup 3 (39%) is not typical of the Fertile Crescent. It suggests a more complex origin, possibly with admixture from later migrations, such as those of Indo-Iranian speakers from the steppes of Central Asia and others from further east. This possibility is supported by the detection of low frequencies of haplogroups 10, 12, and 13 in the Brohis, all rare in Pakistan and typical of East and northern Asia, and Southeast Asia, respectively. These points have been amply demonstrated by Qamar et all in their publication (48) who discount the folklore about the Brohis as being of the West Asian origins.

The Slave Trade: The situation of the Makrani population group in southern Pakistan has been of special interest to a number of anthropologists and geneticists. Some of the early investigators jumped to the conclusion that this population was the living proof for the Out-of-Africa hypothesis of human origins and migration. Some have connected them with the Yemeni and Omani 'farmers' who are supposed to have brought millet to the Indus Valley in the mature phase of the Indus Civilization during the third millennium B.C. Some have drawn our attention to the 'thriving' slave trade, conducted by the Arabs of Oman, between East Africa and the coastal regions of Pakistan and India during the seventeenth century A.D. There is a general belief among the Makranis themselves in this folklore, that is, their ancestors being brought to Baluchistan and Sindh as slaves from Zanzibar, off the coast of Yemen.

The mtDNA haplotypes in the Makrani population have been shown to be identical to those observed

in modern sub-Saharan African populations (75), particularly in Bantu-speaking populations from Mozambique. This indicates the presence of African mtDNAs among the Makrani to be of recent origin. Indeed, in Quanta-Murci's study (77) all but one of the Makrani L1, L2, and L3A types matched Mozambique sequences and these were the most frequent haplotypes in the Mozambique samples. Quintana-Murci's results, however, contrast with the Makrani Y-chromosome profile drawn by Qamat et al, which is similar to that of other Pakistani populations and is dominated by western Eurasian lineages (48). Another study, by the same author (43), shows that the Makrani population carries the sub-Saharan African male-specific haplogroup E-M2 at 9 percent frequency (43) and that would mean their African origins. This haplogroup is, however, present in neighboring populations also, although at a lower prevalence (2-5%), indicating an overall estimate of the African male-specific contribution in the Makrani population to be quite low.

The available evidence boils down to this conclusion: If one relies on mtDNA, then a strong relation to the sub-Saharan population is indicated. However, if one relies on Y-chromosome DNA, then we find no such genetic relationship with the subSaharan Africans. It appears that this gene flow is predominantly sex-specific, i.e. carried through the females, and if the Y chromosomes were initially African, most have subsequently been replaced. These findings must be interpreted in light of known historical data.

The East African migration towards the East began in the 7th century and increased considerably during the Omani Empire. This movement created a strong connection between the Makran port of Gwadar, the principal ports of Oman, and ports located in East Africa, including Mozambique. The African component in the Makrani community may therefore represent the genetic legacy of this economic migration and a possible but not probable slave trade. It has also been hypothesized that whereas the Atlantic slave trade dealt mainly with male labor, the East African slave trade seemingly favored females over males. According to this hypothesis slave women were mainly domestics and or concubines. No evidence for this hypothesis has, however, been offered but this claim has been repeated *ad nauseum.* Since the slave trade on the western front has been a reality and a fact of life, European and American authors did not find any problem in believing that the same would also apply in the East.

The fact is that there was no economic incentive for the Nawabs and Sardars of Sindh and Baluchistan to import slaves from East Africa when serf labor was available at home aplenty. If historic experience is any guide, it appears that the dispersal of Negroid genes in southern Pakistan was a result of a slow economic migration over several centuries. This migration was most probably tilted heavily to females who came as house servants, midwives, and herbalists.

There were probably strong cultural barriers also that hindered African males from fathering children, a situation exacerbated by the proportion of men imported as eunuchs (46). As a consequence of these practices, the contribution of paternal African genes to the population is expected to be low. Indeed, the contrast between male and female African contributions observed among the Makrani strongly supports historical records of a female sex bias during the East African migration.

Other factors, such as asymmetrical mating patterns between African women and autochthonous males during the process of genetic admixture, and/or unequal reproductive success among Makrani males, might have accelerated the loss of African Y chromosomes from the population. A similar

pattern has been reported recently in the Yemeni Hadramawt population (35), geographically adjacent to East Africa, where the African maternal contribution has also been interpreted as the result of sex-specific reproduction regime.

Parsees: The Iranian origins of the Parsis, a small community living in Karachi, are welldocumented. The frequencies of some Ychromosome haplogroups do indeed resemble those in Iran more than those of their current neighbors in Karachi. Qamar et al calculated admixture estimates of the Parsees and came to a figure of 100 percent from Iran on the basis of Ychromosome analysis. Given the small effective population size of the Parsees, the closeness of their match to the Iranian data may, however, be fortuitous for such a high value of admixture index. Other data suggest some gene flow from the surrounding populations. Overall, these results demonstrate a close match between the historical records and the Y data.

Balti: The Balti from the Hunza Valley are thought to have originated in Tibet, where the predominant haplogroups are 4 and 26 (48). Neither of these haplogroups was present in the sample in Qamar at al study (48), providing no support for a Tibetan origin of the Y chromosome lineages and an admixture estimate of zero. However, this result must be interpreted with caution, because of the small sample size and an absence of any mtDNA analysis.

Punjabis: Finally, a note on the Punjabi ethnic group is warranted. The mtDNA study of Quintana-Murci or Y-Chromosome analysis of Qamar et al does not shed any light on this ethnic group of Pakistan beyond the general reading that the majority of the Punjabis share many west Eurasian genes with other Pakistani populations west of the Indus. However, they share in increasing proportions the genetic material which we associate with India or South Asia in general. These affinities are as deep-rooted as they are in the population of Baluchistan, Sindh, and the NWFP. A 2004 Stanford study conducted with a wide sampling from India, including 112 Indian Punjabis, showed that roughly 60% of genetic markers in Indian Punjab were of West Asian origin, the highest amongst the sampled group east of Pakistan. Since there is a distinct and strong cline of western genetic material as we move from East to West, it would be safe to assume that in Pakistani Punjab the share of the western material would be more than 60% and higher as we approach the banks of the Indus.

Summary and Conclusion: In summary, studies have shown that among the Pakistani populations, the basic clustering of lineages is not language-, tribe-, or *Quowm*-specific and that shared lineages across various ethnic boundaries are rather common. Depending on geographic location, the genetic composition of most Pakistani population groups can be reduced to about 30-60 percent India-specific lineages and 70-40 percent to Iran- and West-specific lineages or their branches. The India-specific material is decidedly old: it is more prevalent in the area to the East of the Indus. There seems to be a gradient, in the decreasing order, from East to the West and from the South to the North. Thus, while the populations of the SouthEast corner of Pakistan are rich in Indian-specific genetic material, those in the North-West corner are the poorest. There is no significant contribution of any Orient-specific gene flow except in one population group and there is some contribution in one ethnic group that can be traced back to east Africa. A few Pakistan-specific lineages have also been observed but few details are presently available.

Although ancient Pakistan was geographically linked more to the West than to the East, the genetic evidence shows that during the Stone Age people of Punjab and Sind did interact with the populations of the area which is now Gujarat, Rajasthan, Indian Punjab and Haryana. It appears that these contacts

were probably not limited to the two narrow corridors, alluded to in Section I, but also occurred across the entire Thar when favorable conditions prevailed. The Dry Zone, that is, the area at the edges of the Thar Desert, has seen several “wet” periods of considerable durations in the Pleistocene during which human and animal populations could have easily crossed this geographical impediment in both directions and a considerable gene flow could have resulted. As the Thar Desert shrank during these interludes, the width of the two afore-mentioned corridors of contact between India and Pakistan increased and an easy interaction between various population groups across these terrains became possible. It is around these points, therefore, that we should expect the occurrence of an active gene flow between the population of India and that of Pakistan.

The magnitude of genetic contribution of historic and recent migrations to Pakistan, as compared with that of the Stone Age, is difficult to distinguish from the “native” or “old” genetic base of its peoples. This is doubly problematic when these issues are discussed in terms of linguistic relatedness and ancestral myths. The recent migrations, including the known historical events across the western borders, have left practically no trace in the genetic make-up of Pakistani population groups. Genetic inferences of recent migrations into Pakistan, especially that of the Indo-Aryans, have been sough very diligently by a large number of archaeogeneticists but so far no clear evidence has emerged. If such a migration did happen, the gene flow was most likely miniscule in comparison with the older infusion. The other possibility is that such migrations did not happen to start with. All in all, the general spread of the genetic markings all over Pakistan plus the estimated time scale, does not support a recent massive Indo-Aryan invasion or the eastward march of a seed-bearing farmer group, at least as far as maternally inherited genetic lineages are concerned.

Genetically and culturally, Pakistan is the area where the West (the Middle East and Central Asia) meets the East (India), sometimes at arm’s length and sometime in close embrace. Genetic signatures are present and observable, and the footprints of population movements are discernable. However, it is often difficult to see if these indicators originated in the depths of the past or in relatively recent times. Most of the researchers in Pakistan and the surrounding regions are trying to grapple with this question.

Pakistani populations have been admixed so badly that an accurate sampling of ‘indigenous‘ peoples is virtually impossible. First there was a huge influx of people from East Punjab to West Punjab and Sindh during the settlement of the irrigated lands in this area under the British administration. There was a second wave of ‘eastern‘ peoples after the Partition of Punjab who largely settled on the upper Indus plains. Just after, there was a large wave of peoples from the GangaJamuna doab settling in southern Sindh. One should also not forget millions and millions of peoples coming from Afghanistan and settling in the Pashtun country, northern Baluchistan, and Karachi during 1970’s and 1980’s. This is over and above a constant trickle of people that represents the slow and steady migration of the Hazaras. It is not possible to separate these recently introduce genes from the ‘original’ population in sampling. Thus, one should not expect genuine results from non-genuine sampling of population groups. This is in contrast with the population research in India where the population groups have been largely static and the process of sampling of population groups rather simple.

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The Stone Age

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SECTION V



Stones, Stones, and More Stones

V.1. Stone Tools and their Evolutionary Context V.2. Paleolithic Research in Pakistan V.3. Distribution of Paleolithic Sites in Pakistan V.4. References

V.0. Stones, Stones, and more Stones



Stone tools form one of the primary sources of our information about the activities and behavior of early humans. Within these stones lies much of our evidence of the

beginnings of the patterns of cultural behavior that distinguishes man from other creatures. Accordingly, the evidence for manipulating stone by early humans for the manufacture of tools has been of deep interest to prehistorians, anthropologists, and , of course, to archaeologists since the midnineteenth century. In context of Pakistan's prehistory, these stone artifacts are of special importance since we do not have any fossil record available to us from that era.

The accumulated literature on stone artifacts is immense and while some of it provides us with a much needed insight in the life of early humans and their ancestors in South Asia, it is largely Eurocentric. Stone tools from South Asia, and Far East have only recently started to be looked at in their evolutionary context and are gradually being placed in the various conceptualizations of human evolution over the globe. The point of reference, nevertheless, remains Europe. The evidence from Pakistan, or South Asia in general, does not always fit in this picture but until a new paradigm evolves we do not have any choice but to talk about these stones in European idiom. This we shall do in this Section and the next, occasionally taking a stray glance, whenever we can, away from this fixation.

Recent studies show that the beginnings of the Pleistocene may extend back almost to two million years. The alternating cycles of wetter and dryer periods that characterize the Pleistocene climate of South Asia correspond broadly to the climatic fluctuations of the Mediterranean regions. They are best recognized along river terraces, and it is from these that the cultural evidence for early man's activities also comes. This evidence consists of stone tools used in a hunting and gathering way of life; to crush bones, crack nuts, slash tough skins, and pulp fibrous plants. Because of their durability, the archaeologist concentrates on stones, but tools made of organic materials such as wood and bones must have also been in use.

This section opens with a global review of primitive stone tools, their types, their manufacturing technologies, their geographical distribution, and their chronological context. It goes on to examine the ways in which archaeologists have classified the stone artifacts in order to put some order in the vast amount of data that has accumulated all over the world during the past century and a half. All this provides a good foundation for the material discussed in the next section or two.

This review is followed by a brief account of the history of research in the Paleolithic of Pakistan and a survey of Paleolithic sites where such artifacts have been found. All this provides sufficient background for the appreciation of the material to be presented in subsequent pages.

Those who are familiar with the ubiquity of Paleolithic remains in the subcontinent are well aware that they occur virtually in all ecozones. In Pakistan their presence has been indicated all the way from

the high mountains of the north to the rolling hills of the Pothwar plateau to the marshes of the Indus delta to the hills of Rohri to the plains of Sindh and Las Bela. Late Paleolithic sites have been found in the coastal regions but little has been published yet.

We strive to describe the early phases of the Stone Age in terms of 'industries' or 'traditions' of tool-making and want to see as to how they fit into our knowledge of the general pattern of human evolution, or how do they relate to each other in time and space. Within these limits, it is possible to discern at least some aspects of the lives of the authors of these tool traditions, analyze and dissect the varied technologies which our ancestors employed to fashion their tools, and speculate about the uses to which these tools were possibly put. As we indulge in this exercise, we compare the various regions of the Old World with respect to the types of these tools and try to learn about the dispersal of early humans over the face of Earth.

This is, obviously, a very narrow point of view for looking at man's ancient history. To paraphrase Stuart Piggott, the study of stone tools, devoid of any visible or direct connection with other aspects of human activities, has a certain degree of inhumanity as it lacks relationship to anything we know or can visualize about the life of our ancestors within the comprehensible bounds of human history. Anthropologists are striving to make these connections, climatologists are trying to show the relationship of the prevailing environment to the type of stone tools that early humans developed, and geneticists are trying to trace the movement of humans and attempt to correlate these movements with the frequencies and types of stone tools. Thus, bit by bit, and step by step, we are inching toward having a peek on the life of early humans. In so doing we strive to connect the technological advances of man with the trajectory of his anatomical, behavioral, and cultural evolution.

The utility of chipped stone for mapping the technological progress of early humans and the significance of their employment for following the evolution of man should not be underestimated. It seems unlikely that the omnivorous diet of the *Australopithecus* of the African Rift Valley or the various species of the genus *Homo* could have led to a successful utilization of their hunting or scavenging ability without these supplementary teeth and claws of stone for butchering their kills or picking the abandoned carcasses. The extent to which tools were used in gaining access to otherwise unavailable vegetal resources and to small game and nonmammalian fauna is another aspect of technological development that awaits exploration. Assuming that the above is a reasonable appraisal of the role of stone tools in the technology of Paleolithic man, we can examine the collections of these artifacts available to the archaeologist as indicators of the lifeways of the hominins that made them

It seems likely that the development of these abilities played a significant role in the development of the kind of conceptualization upon which much of the success of man's later cultural adaptation was based. There is little doubt that these abilities changed through time and that the man of the Later Stone Age was far more efficient in this regard than his early Stone Age antecedents. Thus in some respects it is difficult to generalize about the significance of stone tool collections and assemblages for the whole of the Stone Age.

Pakistan was brought within the sphere of scientific study of the Paleolithic with the discovery of some simple stone tools in the Pothwar Plateau. These tools are largely characteristic of East and Central Asia; they belong to a tool 'tradition' which is considerably at variance to that of the West. On the other hand, most of ancient Pakistan seems to be a part of the 'western' culture as indicated by the

presence of the same type of stone tools as are the hallmark of the Near East and Europe. Thus, Pakistan has been a place where the East met West right from the remote past

The presence of stone tools is ubiquitous in Pakistan and there is hardly any area where stone tools of one type or the other have not been fund. This shows that by 500,000 years ago ancient Pakistan was populated all across its length and breadth, to be sure in small pockets and to be sure in small numbers. However, not all regions were occupied continuously. Some were populated in the early parts of the Paleolithic and then at its later stages. Some areas were abandoned permanently but some were re-inhabited after some interval of time.

The study of stone tools give rise to several theoretical questions. For example: are the pebble tools found at certain location in East Africa really prior to those found at Riwat in Pakistan? If yes, then what is the evidence? Is the progression of the tool types and methods of production a gauge of man's increasing intelligence, as many anthropologists tend to believe? Was the stone a preferred raw material for early man to make tools in comparison with other raw materials, such as bone and wood? No satisfactory answers have yet been found to these questions and dissenting voices are getting louder and louder every passing day. Although these questions are interesting, one does not feel comfortable speculating on them.

V.1. Stone Tools and their Evolutionary Context



This chapter is a technological review of the prehistoric tools and their manufacturing techniques in the Old World and their relationship with the overall development of human culture. This is largely a class-room type material but we shall approach it, as much as possible, from historical perspective. To make the narration simple, the narration is largely Eurocentric and the story is what is generally subscribed in the academic circles. This is not to support the view that humans all over the globe followed one single technological path in fashioning their tools all over the World and that their technological progression is typified, if not guided, by Europe or the Near East. Nor is this an acquiescence to the view that the tool-making technologies always travelled from West to East or that the western Paleolithic humans were more "progressive" in their tool-making technologies than the peoples of the East. We follow this line simply because most of the available literature on Paleolithic man primarily deals with the situation in Europe and we therefore do not have any choice but to have this as our starting point. Equally important is the question of terminology. Since most of the paleolithic research has been done in Europe, the terminology for describing the finds is by necessity specific to Europe. This terminology is now widely accepted and understood and we do not find any reason to deviate from it beyond some dissenting notes here and there.

The Paleolithic artifacts are regarded as an index of man's progress towards civilization and the development of the related technology is, in fact, considered a barometer to human evolution. "Prehistoric artifacts should be treated historically, and be assigned respectively to one or other of the several stages of man's progress in civilization", thus spoke Robert Bruce Foote (1916) in the introduction to the catalogue of his vast collection of antiquities made during a period of well over thirty years while working as a geologist in different parts of India. Without entirely subscribing to this notion, we intend to study the primitive stone tools, found in various geographic regions of the Old World in order to establish a baseline for meaningful discussions in the subsequent pages.

Archaeologists generally do not want to talk about stone tools, they would rather speak of the stone 'artifacts'. According to therm, a tool can be anything used as a tool, whether made by human or found in nature. A hurled stone, for example, is a tool but not made by humans. An artifact is an object, whether used as a tool or otherwise, made by humans. The use of the world 'stone tool' has, however, become so common as a synonym of the 'artifact' that there is no point in splitting the hair. In this book we have, therefore, used the 'tools' to mean the 'artifacts' and vice versa.

A stone tool is, in the most general sense, any tool made of stone. Stone tools may be made of *chipped stone* or *ground stone*. Chipped stone tools are made from cryptocrystalline materials such as chert, quartz and obsidian via a process known as *lithic reduction*. One simple form of reduction is to strike stone *flakes* from a *nucleus* (core) of material using a *hammerstone*. If the goal of the reduction strategy is to produce flakes, the remnant lithic core may be discarded once it has become too small to use. In some strategies, however, a flint knapper reduces the core to a rough *unifacial* or *bifacial* preform, which is further reduced using *soft hammer* flaking techniques or by *pressure flaking* the edges. More complex forms of reduction include the production of highly standardized *blades*, which can then be fashioned into a variety of tools such as scrapers, knives, sickles and microliths. In general terms, chipped stone tools are nearly ubiquitous in all pre-metal-using societies because they are easily manufactured.

Paleoanthropologists once considered making tools to be one of the defining characteristics of the genus *Homo*. However, the diversity of toolmaking and tool-using behaviors among some chimpanzees has forced us to completely revise assumptions surrounding the concept of "man the toolmaker". Chimpanzees make and use several kinds of tools for extractive foraging, including leaf sponges, termite and ant fishing wands and probes, marrow picks, levers, pestles, stick brushes for honey extraction, leaf scoops, and hooked sticks to extend their reach. West African chimpanzees use wood and stone hammers and anvils for cracking nuts. Repeated use produces shallow dimpled and pitted anvils and hammers resembling those made by humans. Sharp-edged stone chips (flakes) are occasionally produced but are not used. Incidentally, tool use among forest-dwelling chimpanzees raises questions about the role of adaptation to savannas in the origin of technology.





A Pebble too of Mode 1 **A biface tool of Mode 2**

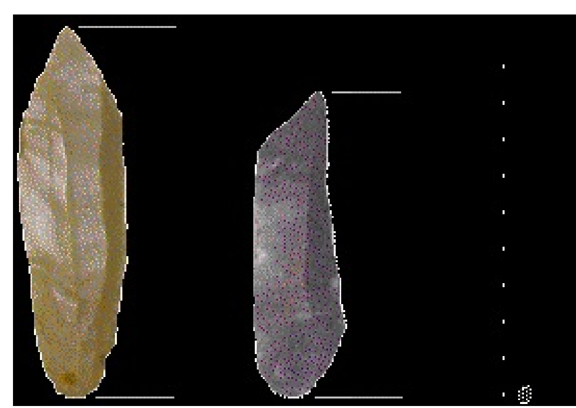


A flake tool of Mode 3

The chipping of stone for the production of tools is, however, unique in humankind and is no way comparable with the tool *use* of chimpanzee and other

apes. Meat eating is often considered the prime mover for the adoption of stone tools. Cut marks

and hammerstone marks on bones of large mammals demonstrate meat and marrow consumption by 2.5 million years ago. However, microwear polishes on



stone flakes demonstrate their use for cutting and scraping

wood and for cutting **Two blade tools of mode 4**

s i l i c e o u s p l a n t s (reeds, sedges, or grasses) in addition to cutting meat.

Sharp-edged cores also undoubtedly have several potential uses. Pointed bone fragments from South African cave sites have polished tips, possibly from perforating soft materials, and coarser abrasions resembling those resulting from digging in stony soil.

Classification of Stone Tools Traditions and Tool-making Technologies: The array of stone tools discovered in different parts of the world and their respective variations in the course of time is truly large. A systematic classification of these tools and the identification of the technology for their manufacture is therefore necessary for simplifying the study of this evidence of human past. A large amount of efforts has been expended on classifying and re-classifying of stone tools in Europe as well as in other parts of the world. This was a worthwhile effort and it has yielded quite useful results. But, as Bridget and Raymond Allchin (33) have aptly stated, the problem is that they tend to become traditions in themselves, sometimes to the extent of being accorded almost the significance of dogma, which is unfortunate as it leads to new material being forced into categories that do not fit. “A system can all too easily become a tyranny instead of an aid to understanding”, they wrote. We shall, therefore, be flexible in our approach.

Archaeologists have divided the stone tools into several major and widely varying groupings, which presumably represent a similar grouping of human traditions or ‘cultures’. A basic division is simply into *core* and *flake* tools. In the former group, a tool is made by flaking or chipping away from a parent block until the resultant form is satisfactory for the intended use. In flake tools, however, the first process is to detach a large flake from a block of stone and then to work this into the finished tool. Some regions of the world have predominated with tools fashioned from cores while others show the predominance of tools that were manufactured from flakes. This division of manufacturing techniques is also evidenced with reference to time: the earlier stone tools are generally core-tools and the later generally flake-tools. The production of core tools naturally produced flakes in the very process of manufacture, and these were in turn often made into tools.

“A system can all too easily become a tyranny instead of an aid to understanding”
(Bridget and Raymond Allchin)

Other, more elaborate divisions of stone tools have been suggested: one commonly used classification is with reference to the ‘modes’ of stone-working techniques or the ‘traditions’ of stone tool manufacturing. Four fundamental traditions or *modes* of production were developed by our Paleolithic ancestors all over the populated earth:

The *Mode 1* industries (Oldowan, Clactonian) or pebble-tool tradition created rough flake tools by hitting a suitable stone with a hammerstone. The resulting flake would have a natural sharp edge for cutting and could afterwards be sharpened further by striking another smaller flake from the edge if necessary (known as retouch). These early toolmakers may also have worked the stone they took the flake from (known as a core) to create a core tool.

The *Mode 2* industries or toolmakers of handaxe tradition (eg. Acheulian, bi-face) also used the Mode 1 flake tool method but supplemented it by also using wood or bone implements to pressure flake fragments away from stone cores to create the first true hand-axes. The use of a soft hammer made from wood or bone also resulted in more control over the shape of the finished tool. Unlike the earlier Mode 1 industries, the core was prized over the flakes that came from it. Another advance was that the Mode 2 tools were worked symmetrically and on both sides (hence the name Biface) indicating greater care in the production of the final tool.

Mode 3 technology, or the flake tradition emerged towards the end of Acheulean dominance and involved the Levallois technique. It is commonly associated with Mousterian industry (see below).

Mode 4 or the blade tool tradition is the most recent one and it represents the true dexterity of the ‘modern man’.

According to another classification, tools and tool-making technology of the Stone Age is divided into four fundamental Paleolithic traditions: 1. pebble-tool traditions;
2. bifacial-tool, or hand-ax, traditions;
3. flake-tool traditions; and
4. blade-tool traditions.
This terminology and classification roughly corresponds with the four fundamental traditions of tool making, described above. Only rarely are any of these found in "pure" form, and this fact has led to mistaken notions in many instances concerning the significance of various assemblages. Indeed, though a certain tradition might be superseded in a given region by a more advanced method of producing tools, the older technique persisted as long as it was needed for a given purpose. In general, however, there is an overall trend in the order as given above, starting with simple pebble tools that have a single edge sharpened for cutting or chopping. No true pebble-tool horizons had yet been recognized in Europe. In southern and eastern Asia, on the other hand, pebble tools of primitive type continued in use throughout Paleolithic times.

Many of the lithic techniques followed by the prehistoric man around the world are named after the French or other European sites, for example, Acheulian after St. Acheul and Levallosian after Levallois, both in France, where particular types of tools were discovered first. The hand axe industry of the peninsular India came to be referred to as Madrasian because the first handaxes were discovered by Foote in 1863 near Madras. The somewhat different industries found by de Terra and Paterson in the Soan Valley in Pothwar seventy years later were called Soan industry. These terms, it may be noted, are used just to indicate similarity between tool types and do not imply any cultural connection or diffusion from one area to another.



The Pebble Tools: The very first stone tools were probably naturally broken, sharp-edged rocks that were casually picked up, used and discarded. At some point, however, early hominins began
lecting specific
purposely seraw materials,

and making their own sharp-edged stone tools. The earliest manifestation of this behavior has been called the Pebble Tool Tradition, because it entailed the sharpening of pebbles and small cobbles through removal of flakes or simply breaking it into two. Although it was thought for years that the sharpened pebbles were the desired end product; new evidence from the analysis of microscopic wear patterns on the flakes indicates that the flakes may actually have been the tools, used for general purpose cutting. The cores, however, would also have been useful as heavy choppers or chopping tools. Thus, the early toolkit of the ancestors of man consisted of large flakes and sharp-edge pebbles from which one or more flakes have been removed.

Pebble tools are among the most common forms of earliest stone tools, a large percentage of which are thought to have been made by Homo *habilis* nearly 2.5 million years ago. They are not always easy to recognize as they are heavily worn and rolled, devoid of sharp edge which one would expect to see. And, as they continued to be made through to Neolithic times, they are not, as such, cultural or chronological markers. Therefore, unless they are discovered in a datable context, in a group with other more culturally or chronologically distinct artifacts, or in association with hominin skeletal remains or other evidence, they cannot be taken as an indication of great antiquity.

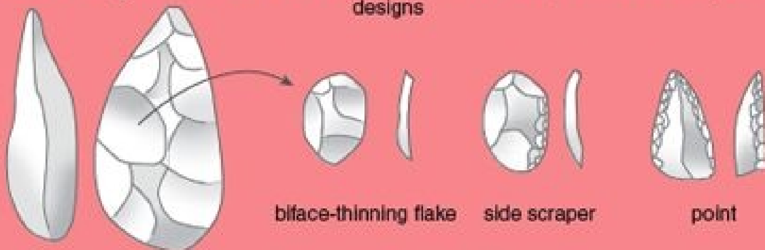
The Oldowan tool tradition represents the first manufacture of any tool noted in the archaeological record. This tool tradition takes its name from Olduvai Gorge, Tanzania, where the first Oldowan tools were discovered by Louis Leakey in the 1930s. In the current archaeological technical chronology the Oldowan is also called "mode 1" preceding "mode 2", or Acheulean technology. Oldowan tools are sometimes subdivided into types, such as chopper, scrapers and pounders, as these appear to have been their main uses. All of the known uses for these tools involve processing food, butchering, chopping, scraping and pounding, not hunting. Their use lasted to as late as 0.5 million years ago (34). In Pakistan, their use is indicated in the Pothwar Plateau some 2.0 million years ago, lasting probably to second millennium B.C. Simple pebble tools have been found in some other regions of the world also: "Oldowan" therefore does not properly refer to a culture, but to a very simple tradition of tool manufacture that was in use for a long time

Most pebble tools were made by a single blow of one rock against another to create a sharpedged piece. The best tools of Mode 1 genre were

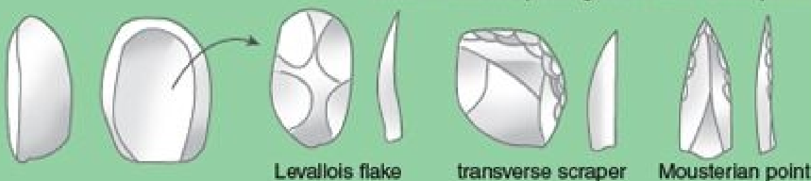
mode 1 pebble cores — shapes of retouched tools largely detemined by shape of flakes



mode 2 large bifacial core tools — broader, thinner flakes, some function-specfic designs



mode 3 prepared cores — standardized forms (possibly for hafting); heavy retouch indicates prolonged use and resharpening



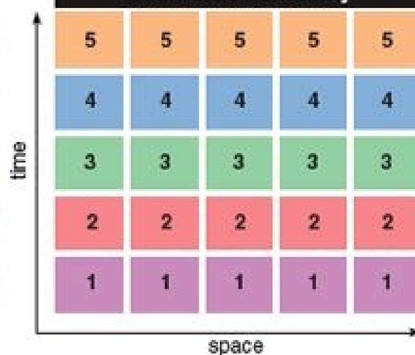
mode 4 prismatic-blade cores — standardized rectangular shapes modified into specialized forms; many tools attached to handles

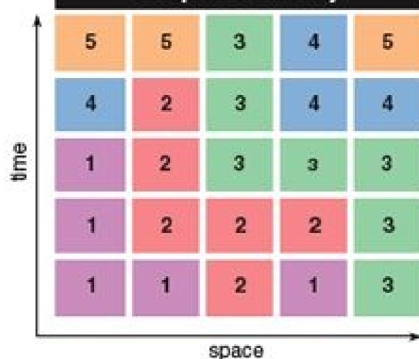


mode 5 geometric microliths — flakes or blades broken into small retouched geometric shapes; most tools attached to handles









struck from crystalline stones such as basalt, quartz or chert, and the prevalence of these tools indicates that early humans had learned and could recognize the differences between types of rock. The Oldowan pebble tools from East Africa have been extensively studied and theorized. What specifically identifies Oldowan tools is that they are obtained with very few knocks, sometimes only one. The resultant tools are misleadingly crude. The size of the roundshaped cores is variable, but they usually fit comfortably in the hand; they are tennis-baIl-sized stones in east Africa but somewhat larger in other regions, such as Pothwar, where they are struck from larger pebbles. The finished product had a jagged sharp edge, efficient for cutting and chopping.



Pebble tools from Oldovai, East Africa

Sometimes these pebble tools, or Mode 1 tools, are called the Chopper-Chopping Tools. A chopper is a unifacial tool with a single straight or curved cutting edge flaked from a pebble or from a chunk of stone. It is, in effect, the most basic stone tool which a hominin could have ever fashioned. Unlike the crude chopper, the chopping tool is created by removing flakes from two sides of a lithic core. It is a true biface tool although not as finely worked as the later handaxe which is worked all over its surface into a more ergonomic shape with pointed tip and rounded butt end. The cutting edge of the chopping tool is not straight as the flaking from either side gives it a sinuous appearance when viewed end-on.

Chopper-Chopping Tools figure quite prominently in tools tradition of East Asia. These traditions include the Choukoutienian industry of China (associated with *Homo erectus*), the Patjitanian industry of Java, and the Anyathian industry of Myanmar (Burma). This tradition of tool making had an extreme longevity, particularly in what are now China and Southeast Asia - about 1.5 million years without a significant change in technology. Chopper-Chopping Tools also remained quite prevalent in northern Pakistan, in the Soan Valley, north of Punjab, for a long time, almost up to 800,000 years ago, in the form of the Soan Industry. We do not observe their presence, however, in southern Pakistan or in peninsular India. Tools of this tradition have also been found in Central Asia and in its North. Movius drew a line across Asia, the North of which he designated the region of the Choppers-Chopping tools while the South of this line represented the geographic region where the Acheulean tools were more common. How this tradition evolved in East and North Asia is unknown; how it got out of Africa; who carried it to East Asia and northern Pakistan and Central Asia is equally uncertain.

The choppers and chopping tools of the Pothwar Plateau are considerably larger than those from East Africa. Contrary to their African counterparts, in Pothwar they are not always made on rounded pebbles. Furthermore, the Pothwar tools are largely flakes while those in East Africa are largely cores. The generalized form of the choppers and chopping tool suggests that it served many

purposes, such as butchering meat, splitting bones for marrow, and perhaps also defending the owner.

Mode 1 assemblages have been classified on the basis of shared attributes, usually consisting of pebbles and cobbles that have been unifacially and sometimes bifacially struck along their edges. The degree to which unifacial and simply struck bifacial tools are regularly made leaves some question as to whether these pieces were intentional

morphological designs on the part of the tool manufacturer. Similarities and differences of stone tool 'forms' in these assemblages may simply represent variations of flaking produced through hard hammer percussion to stone, and not be representative of 'mental templates'. As a consequence, some analysts now prefer to abandon the traditional, culturally loaded, terminology used to designate these assemblages (e.g. Chopper-Chopping Tool, Soan Industry, etc), instead preferring to classify these assemblages as 'core/flake' or Mode I technological classifications.

Since no positively identified australopithecine fossils have ever been found outside of Africa and, until they are, we cannot assume that *Australopithecus* was the exporter of the chopping tools. It seems more likely that Homo *erectus* was perhaps the carrier of this technology out of Africa to the Old Word of Eurasia. The exodus of Homo *erectus* from Africa is believed to after 2 million years ago - probably around 1.7 million years ago - but some of the tools in Eurasia, especially those found in Pathway date to more than 2 million years ago. This is indeed an archaeological enigma: if we put our faith in the manufacture of these tools with Homo *erectus*, we must then also believe that the exodus of Homo *erectus* from Africa happened considerably earlier than is commonly stated. Alternatively, it could be assumed that Oldowan tools were produced by several species of hominids ranging from *Australopithecus* to early Homo *erectus.* We have discussed this issue in Section II and we shall revert to it again.



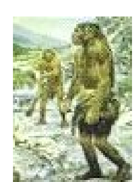
Acheulean Industry or Handaxe Tradition*:* The next major technological advance in the production of stone tools is exhibited in the Acheulian Handaxe Tradition or Mode 2 technology. Although the number of different types of tools increased compared to the Chopper-Chopping Tool Tradition, the real hallmark of the Acheulian tradition is the craftsmanship and efficiency displayed in creating more cutting edge per unit of raw material. The key innovations are (1) chipping the stone from both sides to produce a symmetrical (bifacial) cutting edge, (2) the shaping of an entire stone into a recognizable and repeated tool form, and (3) variation in the tool forms for different tool uses. Manufacture shifted from flakes struck from a stone core to shaping a more massive tool by careful repetitive flaking. This progressive refinement of lithic tool production becomes obvious when compared with the earlier tool-making traditions, such as chopperschopping tools.

Although Acheulian is very frequently used to describe certain types of stone artifacts as though its meaning is as clear as it appears to be, the definition of Acheulian is by no means clear. Put in simple terms, Acheulian assemblages are the stone artifacts with a substantial component of elaborate bifacial edge. Handaxes, scrapers, picks and cleavers are the most common form. In the African Acheulian, these are primarily made on large flakes and often of basalt or similar igneous rock. In Europe, these are most often made of flint nodules. Usually, Acheulian assemblages also contain smaller amounts of various other tool types.

The Acheulian technology appears in Africa around 1.4 to 1.7 million years ago from where it is supposed to have diffused to South-West Asia and other parts of Eurasia. The oldest securely dated Acheulian site is that of Konso-Gardula in Ethiopia, where Acheulean tools have been recovered from underneath a tuff layer which has associated ages of 1.34 and 1.38 million years. Some of the earliest Acheulian occurrences in Olduvai Gorge might date as far back as 1.6-1.7 million years. During this early period of Acheulian occurrence, the presence of the Acheulian is geographically restricted to the African tropical savanna environments. In Europe, it is only after 500,000 years ago that Acheulian bifaces appear.

Acheulian tools are believed to be associated with *Homo ergaster* or his Asian counterpart, *Homo erectus*. Just like the Pebble Tools and Choppers-Chopping Tools Traditions, discussed above, the Acheulean Tradition had a great longevity, on the order of more than a million years. Acheulian assemblages are found in abundance throughout the subcontinent in varying geological, temporal, and technological modes. The earliest known Acheulian localities in South Asia are from Pothwar in Pakistan. Here the Acheulian assemblages provide the earliest confirmed dates: the handaxes at Dina and Jalalpur date back to some 500,000-700,000 years ago. The expansion of the Acheulian into India appears to have been broadly contemporaneous with Pakistan, i.e. Some 500,000 years ago.

Acheulian tool assemblages generally
prise ‘cleavers’ and



com‘handaxes’ although they contain smaller amounts of various other tool types, such as choppers, chopping tools, scrapers, denticulates, notches, and blades. Though our knowledge of most of these tool types is imperfect, it is certain that they served a variety of functions like butchering and skinning of animals, breaking bones for extraction of marrow, digging of roots and tubers, processing of plant foods, and making of wooedn tools and weapons. Acheulian hand-axes were somewhat larger than cleavers and were usually pearshaped.

The essential features of an Acheulian tool are that they are chipped all over instead of only at one end and the core all over instead of only at one end or on one side. This may seem like an awfully small improvement, but it was a fundamental one made possible to much more efficient tools. The required technique is altogether different from Oldowan. The production of an Acheulian tool required the succession of strikes which contrasts with the few unorganized strikes required to manufacture the earlier tools. Acheulian tools show a regularity of design and manufacture that is maintained for over a million years. This is clear evidence for special

**An Acheulian scraper**

and it fashion

A cleaver

**A classical handaxe**

**An Achuelian borer**

handed down by explicit socialization within a geo*Handaxe* is generally considered as a chargraphical area.The Stone Ageacteristic feature of the Acheulian tool-making tradi
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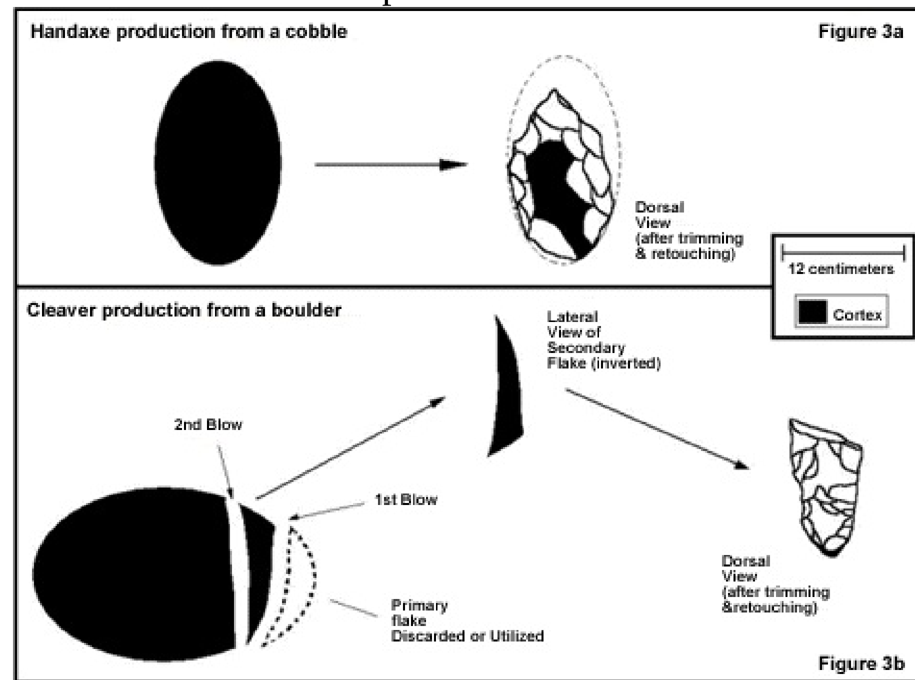
which that particular type of tool belongs. The term the relation of the hand-axe with the Acheulian, we can refer to the parallel relation of the “chopper



An Acheulian handaxe found at Omo Kibish in Ethiopia An Acheulian handaxe found at Omo

Kibish in Ethiopia Acheulian, therefore, does not represent a common culture in the modern sense, rather it is a basic

chopping tools" to the Oldovian: one is the use
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name while the other represents the 'industry' to
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Acheulian, therefore, does not
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Acheulian biface production techniques from boulders and cobbles

295

years, gradually achieving a high levelbasic method for making stonerefinement and variety of size and form. This is by far the longest tool-making tradition known.tradition of making handaxes

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Roughly pear-shaped, the

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scraping skins, chopping wood, digging holes, hammering anything, and perhaps as a last resort defending against wild animals. Handaxes come in many shapes and sizes, and in many styles unique to cultures of specific periods or specific geographical areas. Almost all handaxes have a point, are sized for the hand and shaped to be held.

There are several other types of bifacial or Acheulian tools which essentially stem from handaxes. For example, cleavers have a sharp, thin, usually unmodified edge transverse to the long axis, actually looking much more like a modern ace head than the ancient hand-axe did. It was probably used for heavy chopping or for hacking through joints of large animals, or even splitting wood. Picks and knives have convergent tips, like handaxes. Picks have a thick cross section at the midline, and knives have one thick lateral margin. Although the descriptive names imply different functions for handaxes, cleavers, knives, and picks, microwear studies show that these may have been multipurpose tools.

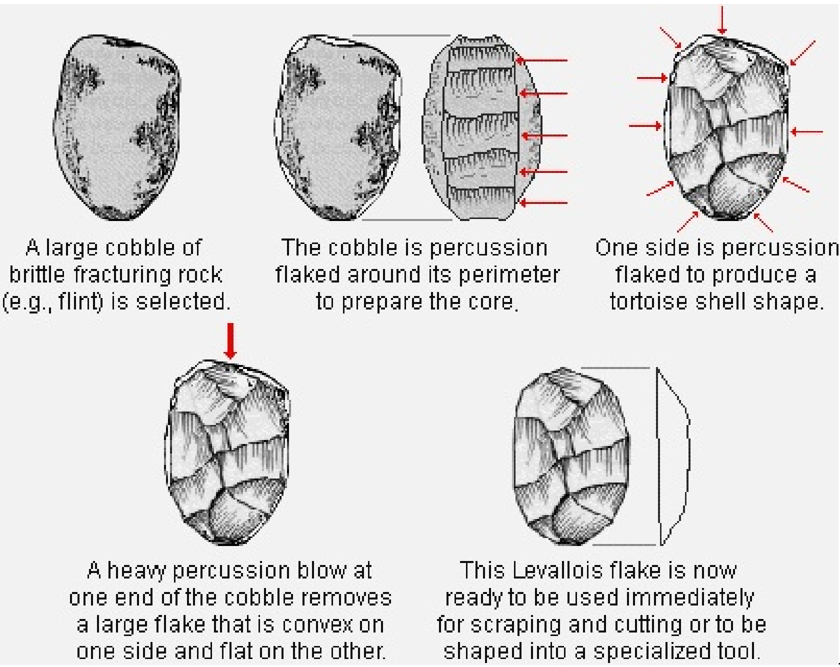
Flake Tools Tradition: Acheulian tradition lasted quite long, changing little or very slowly. The evolution of lithic technology, however, accelerated *ca.* 300,000 years ago, during the Middle Paleolithic and its South Asian correlate, the Middle Stone Age. These advances were probably made by archaic Homo *sapiens*. Regional stylistic and technological variants are clearly identifiable, suggesting the emergence of true cultural traditions and clearly defined culture areas. Large core tools were supplanted by smaller tools through the so-called Levallois core technology, which is a sophisticated strategy for efficiently producing relatively standardized artifacts, and may reflect more complex cognitive abilities. Stone-tipped spears, knives, and scrapers mounted in shafts and handles represent an order-of-magnitude increase in technological complexity that may be analogous to the difference between primate vocalizations and human speech. The transition was, however, not uniform everywhere.

Flake tools are not unknown in previous cultures. Certainly, even at Olduvai, hominins had been taking advantage of sharp-edged flakes and even modifying them for specific tasks. A considerable portion of Acheulian tools were made on flakes. The important difference in the Middle Paleolithic is that cores were being carefully shaped to produce flakes of a predetermined size and shape.


A retouched flake tool

The flakes were then further modified into both simple and complex tools.

The Mousterian industry is the most prominent tradition of this period. It appeared around 300,000 years ago and persisted until about 30,000 years ago, in much the same areas of Europe, the Near East, South Asia, and Africa, where Acheulian tools appear. In Europe these tools are most closely



A presumed method of producing Levallois flake

associated with *Homo neanderthalensis*, but elsewhere were made by both Neanderthals and archaic *Homo sapiens*. Tool forms in the Mousterian industry display a wide range of specialized shapes. Cutting tools include notched flakes, denticulate (serrated) flakes, and flake blades similar to Upper Paleolithic tools. Points appear Th.at seem designed for use in spears or lances, some including a tang or stub at the base that allowed the point to be tied into the notched end of a stick. Scrapers appear for the dressing of animal hides, which were probably used for shoes, clothing, bedding, shelter, and

carrying sacks. These accumulating material possessions imply a level of social organization and stability comparable to primitive humans today.
Mousterian tools required a preliminary shaping of the stone core from which the actual blade is struck off. The toolmakers either shaped a rock into a convex surface before striking off the raised area as a



A Mousterian pointer from Western Europe

wedge shaped flake (see the illustration), or they shaped the core as a long prism of stone before striking off triangular flakes from its length, like slices from a baguette.

TheLevalloistechniqueofcore preparation and flake removal is the earliest of the core preparation technologies and is considered to be an important step in the technological progress of man in the Middle Stone Age. The technology works in four distinct stages. First the edges of a

cobble are trimmed into a rough shape. Second, the upper surface of the core is trimmed to remove cortex and to produce a ridge running the length of the core, Third, a flake is removed from one end of the core to produce an even, flat striking platform for the blow that will detach the flake. Finally, the end of the core is struck at the prepared platform site, driving a longitudinal flake off of the core following the longitudinal ridge. There are two distinct advantages to this technique. The first is that the flakes removed in this manner are already in a preliminary

shape, and only require minor modification before being put to use. Second, more usable cutting edge per pound of raw material can be made this way than can be made otherwise.

The Levallois technique is thought to have first been used inEurope *ca.* 250,000 years ago, and then perfected *ca.* 100,000 years ago. The use of this technique is believed to be a significant change in culture and shows an increasing growth of cognitive ability, as one that is using this method must be able to imagine the end product and maintain that image while conditioning the stone to the desired shape and end result tool.

The Disk Core Technique is not significantly different from the Levallois Technique. The technology still depends on careful core shaping and preparation in order to remove ready-to-use flakes for tools. The principal difference in the Disk Core Technique is that even more refinement and skill went into the core preparation so that more flakes could be removed from one core. Thus, the Disk Core technique is really a refinement of trends started by the Levallois technique. The exhausted cores left behind by this process often look like small disks with multiple flake scars, hence the name

We do not find a uniformly predominant flake industry in Pakistan during its Middle Stone Age but we do detect Levallois-Mousterian influences visible in the later Soan industries. In Pothwar, Paterson and Drummond found a number of cores which are skillfully flaked on the upper surface, implying a clear preparation of the core. A few parallel-sided blades and elongated flakes also appear, which

strengthen the general impression that the Late Soan is definitely "Levallois" in character. In a later stage of Late Soan, nearly 50 percent of the flakes show faceted striking platforms. This assessment gains further significance in light of the discoveries made by Dani in the Sanghao caves near Mardan. These correlations of the Middle Stone Age flake tools from Pothwar, strenuously made by Paterson and Drummond, Sankalia, and Dani are, however, misplaced. Although some resemblance of technology could be detected here and there, to look for Levallois-Mousterian parallelism to Homo *neaderthalensis*specific is stretching the archaeological imagination a little too far. The Middle Stone Age tool-making technology need not necessarily correspond with the Middle Paleolithic Europe.

Blade and Burin Tradition*:* The Later Stone Age of South Asia and the Upper Paleolithic of Europe is characterized by blade and burin technology. A blade is a long, parallel-sided flake made



Production of prismatic blades from prepared cores – a hallmark of the Upper Paleolithic period

from hard stone such as flint or obsidian. In order to be termed a blade, the flake must be at least twice as long as it is wide. Blade manufacture involves several steps, beginning with selecting the right shape core, shaping the core, and then striking the core at precisely the right places to produce a blade of the desired size. Levallois as well as prismatic technique has been used for producing blades. The former, better known for the production of elongated flakes, was especially common during the Middle Paleolithic while the prismatic technique became more widespread during the Upper Paleolithic.

Levallois methods are confined largely to the Middle Paleolithic of Europe and Africa. In Sindh and to some extent in the northwestern area around Mardan the evidence for both Levallois and prismatic techniques has been collected. In the Upper Paleolithic of Pakistan, the Levallois technique seems be more common in the northern areas, while the prismatic prismatic technique is more common in Sindh. The raw material in the North is quartzite and that in the South is chert from Rohri Hills and occasionally agate. While chert is amenable to produce relatively long blade, quartzite and agate produce rather stubby blades or bladelets.



Cores from which blades have been peeled off, most likely from the Upper Paleolithic but possibly of later date, at Rohri Hills, in upper Sind.

Prismatic blade production has often been described as offering marked advantages over other means of manufacturing blanks for stone tools. One potential strong point concerns the economy of raw material, the number of blanks that can be produced from a given unit of stone. It is frequently stated that prismatic blade production can provide a vastly greater length of usable edge per unit of raw material than other blank manufacture techniques. However, there is no experimental literature on the relative productivity of hard hammer blade production.

Essentially, Levallois production concentrates on the exploitation of a single surface of flake detachment, gradually flattening (and shortening) the core as reduction proceeds. In contrast, prismatic blade manufacture is thought to involve systematic exploitation of the entire volume of a nodule of raw material. The production of prismatic blades may thus consume a given volume of raw material more effectively and completely. It has been hypothesized that prismatic blade technology might have provided distinct advantages to toolmakers where raw material was at a premium, due either to a scarcity of suitable stone or to limitations imposed by high residential mobility. This opinion, however, goes counter to the findings at Rohri Hills where the raw material was plenty and it was readily available as chert nodules. Furthermore, here all sites are ‘factory sites’ which means that the raw material need not be carried away for converting into discarded, “low quality” blades, and work-in process pieces have been reported strewn at each site over a number of sites.

A number of additional potential advantages have been attributable to blade technologies. Prismatic core techniques, in particular, permit close control over the dimensions of blanks, sometimes resulting in a remarkable degree of standardization in the sizes and shapes of end products. Such uniformity of products could be a distinct advantage when manufacturing replaceable components of composite tools, a theme to which we will return shortly. Laminar blanks may also provide greater potential for resharpening than flakes, particularly



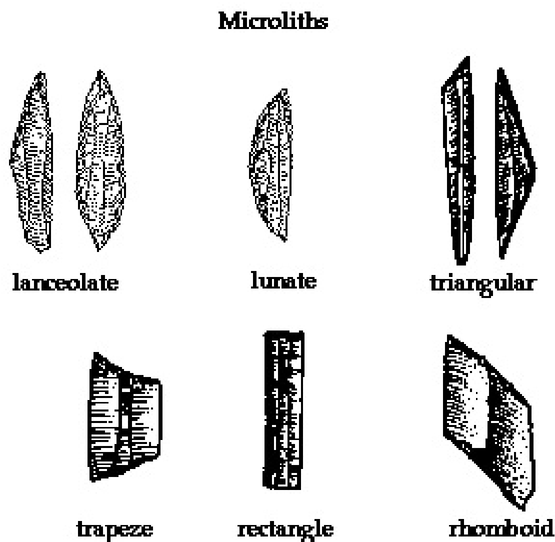
A heap of discarded cores and work-in-progress debitage at Rohri Hills presumably from upper Paleolithic period

when the working edge is on the end of the blade. Although they have some notable strong points, it is important to point out that blade technologies have a number of potential limitations as well. Blade production is risky, prone to "fatal" errors, mistakes that render a core useless without extensive reworking. The production of elongated, laminar blanks also tends to be quite demanding of raw materials. Long, thin blades are comparatively fragile, yet significant force is needed to detach them. The raw material must be brittle enough that a fracture will carry over the desired length of the blade, yet also sufficiently homogeneous and tough so that the blades will not shatter from the force of percussion or pressure. As a consequence, blades were most often manufactured on isotropic, fine-grained raw materials such as flint, jasper, chert, and obsidian, although coarser-grained materials were sometimes employed if they were sufficiently isotropic. The need for homogeneous material may in turn require stringent selection or importation of raw materials, at some cost in terms of time or effort in many geological contexts. Properly setting up a face of detachment for blades often requires extensive preparation, placing further limits on minimum sizes of nodules

The blades, in turn, made it possible to manufacture such very useful implements as burins. These two tools, blades and burins, opened up a whole new world of wood and bone working with an ease and efficiency never previously matched. Blade and Burins are, however, not typical tools of the Middle Paleolithic. Instead, they typify the Upper Paleolithic of Europe and the Late Stone Age of Pakistan. This period, spanning from *ca.* 50,000 to 15,000 years ago, was a period of incredible diversity and technological innovation. Lithic technology underwent an important change during this period. The trend towards increasing the efficiency of stone tool production reached its pinnacle during which the development of blade technology and the tools that blade made possible.

Blade technology is often associated with the coming of the ‘modern man’, which in European context goes only as far back as 50,000 at the most. The evidence for modern tool-making is, however, available from as early as 300,000 years ago from Kapthurin in Kenya and Twin Rivers in Zambia. In Pakistan also, the blades made through the so-called Levallois technique are in evidence in the same timeframe; we see their appearance as far back as 350,000 years ago in Pothwar. This timeframe of 300,000 years ago creates a puzzle because it is at least 150,000 years earlier than the fossil evidence is available for anatomical modernity and at least 250,000 before the perceived behavioral modernity. This apparent time gap has led some anthropologists to subscribe to the “brains before body” view of modern human evolution.

Microliths: A microlith is a small stone tool, typically knapped of flint or chert, usually about three centimeters long or less; They are typically one centimeter long and half a centimeter wide when finished. Microliths were either produced from small blades (microblades) or made by snapping normal large blades in a controlled manner, which leaves a very typical piece of waste. The latter type of microliths are called geometric microliths. They can be formed as various kinds of triangles, lunate shaped, trapezes, etc. Microliths were produced during the last part of the Stone Age, a time period which has been designated in Europe as Mesolithic. It spans from the end of the Ice Age to the beginning of agriculture and animal domestication, *ca.*10,000 years ago. In Pakistan we do not have a



discrete or well-defined Mesolithic period but the tail end of the Stone Age does show a widespread presence of microliths, which lingered on up to the beginning of the Iron Age *ca.* 800 B.C. We shall talk about them a little more in a separate chapter.

Composite Tools: The adoption of prismatic blade production and the widespread production of microliths accelerated the development of composite tools. Although simple hafted knives, scrapers or points were probably a part of the early Upper Paleolithic technological repertoires, there is much evidence the number, diversity, and complexity of multi-component tools increased during the later part of the Upper Paleolithic, i.e. the Later Stone Age. The use of bone, antler, wood, and ivory as a haft is common in many assemblages where environments and climate have preserved such evidence. Even when such artifacts are not preserved, the presence of backed or marginally retouched bladelets, too small and narrow to have been handheld tools, attests to the use of hafts or armatures of highly perishable materials such as wood. In Pakistan we do not have any preserved specimen of this nature from the early Upper Paleolithic but certainly have a few superb examples of composite tools from the later period at Mergarh in eastern Baluchistan.

Greater reliance on composite tools implies a need for interchangeable parts. Blades, and especially bladelets, are ideal for this application. We emphasize, however, that this argument does not presuppose that everything in late Upper Paleolithic assemblages was hafted, or even that all blade tools served as parts of composite implements. In fact, it is seldom the case that all tools in Upper Paleolithic assemblages were made using blade blanks. Other methods for working stone are likely to have been employed where they offered particular advantages, or where the potential benefits of prismatic blade production did not counterbalance the risk of failure or raw material requirements involved. At the same time, expertise in particular modes of production would be expected to bleed over into blank production for other purposes: skills acquired in making uniform blanks for use in

composite tools would inevitably be turned to making larger blades to be used as blanks for hand-held implements.

The burgeoning complexity of composite artifacts during the late Upper Paleolithic reflects more than a simple increase in the cognitive capacity or technological competence of humans: after all, hafting itself has a very long history. A more comprehensive explanation requires that one consider disadvantages and costs as well as benefits. The potential advantages of composite tools with interchangeable parts are numerous. Multipart artifacts with easily replaced components may offer increased effectiveness, reliability, and maintainability,



A composite stone tool, probably a saw or a sickle, from Baluchistan

A composite tool, probably a saw or a sickle, from Mehrgarh, Baluchistan. Binding material is bitumin

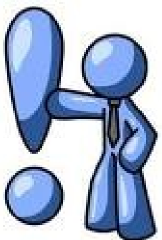
although admittedly these properties have seldom been measured experimentally. The integration of tough, flexible components of bone, antler or hardwoods into weapons and other resource procurement tools reduces the likelihood of catastrophic failure. Moreover, the parts most likely to fail - brittle stone inserts are inexpensively and easily replaced. Yet this improved functionality is not without costs. Elaborate tools may afford users increased effectiveness or time utility in the procurement and processing of resources, but they also require a greater investment of time and

energy, effort which could in principle be put to other fitness-enhancing pursuits such as foraging, mate acquisition or child care.

The increasing importance of elaborate composite tools in some parts of the world over the course of the Upper Paleolithic may reflect a significant shift in patterns of allocation of technological effort and a change in the social networks of the producers of these tools. As stated above, the creation of elaborate technological aids to foraging or other work carries with it a significant amount of "frontloading," expenditure of time and energy well in advance of any possible return. This requires a certain degree of foresight on the part of toolmakers. Perhaps more importantly, it requires a significant amount of cooperation and coordination of activities among members of a social group. The investment of significant amounts of time and labor in the production of elaborate items of technology, the potential benefits from which might not be realized for days, weeks or even years, means that individuals were free to divert this time and labor from more immediately pressing concerns such as getting food or shelter. If an individual is able to devote many hours or even days to the manufacture of an artifact, someone else must be carrying at least part of the load with respect to gathering and processing other resources. This "division of labor" might well have been transitory and minor compared with the kinds of occupational differentiation seen in later and larger-scale societies, and we are not arguing for rigid, permanent occupational specialization during the late Upper Paleolithic, just before the onset of the Holocene.

Raw Material: It is almost certain that man used wood and bone from the very beginning, perhaps even before stone. However, these substances are much less durable than stone, and almost all surviving tools that we have from antiquity are those of stone. The use of bone tools formed an important feature of the Upper Paleolithic period in Europe, but in Pakistan or anywhere else in south Asia bone tools have been reported only from one site in Baluchistan, and that too in small numbers and in post-paleolithic context. The extent to which Paleolithic man manipulated and modified materials other than stone remains a matter of speculation due to the almost complete lack of preservation of most organic substances in Lower and Middle Pleistocene contexts.

While the non-lithic materials are amenable to shaping and modification by cutting, chiseling, and abrasion, there is virtually no evidence for the employment of these techniques on what must have been relatively abundant raw material, namely bone. Instead, when bone is employed for tool manufacture, it appears to have been worked by the same techniques that we see employed in the shaping of stone, i.e. by chipping. Probably because deliberately chipped bones appear somewhat similar to bones smashed for marrow or otherwise broken in butchering, extensive studies of deliberately shaped bone in the Paleolithic are rare. Nevertheless, some examples of Paleolithic chipped bone have been reported from as widely scattered localities as central Spain and Northern China, suggesting that bone may have been a more important item in the technology of these early humans than has been appreciated by lithic-oriented prehistorian.



Summary: The above review of paleolithic tools and the progressive development in their

manufactureng technologies covers a lot of material and needs a summation.
First, stone tool making and use can

be demonstrated to have an extreme antiquity, dating to at least 2.5 million years ago in East Africa, about two million years ago in the Pothwar region of Pakistan, and comparable dates in some other parts of the Old World. It may be that hominids were using stone tools earlier, but beyond a certain point it is extremely difficult to distinguish intentional use wear from naturally occurring wear.

Second, the basic techniques of stone tool manufacturing also have great antiquity. The overriding objective was to create a sharp edge or point on a given piece of stone by chipping with a blow, hard or soft. Thus, the history of lithic technology is marked by changes in the way in which this technique was applied rather than by marked changes in the basic technique. After all, there are only so many ways to break a rock to make a sharp edge. The real changes occurred in the strategies for combining these techniques into increasingly efficient methods for manufacturing useful implements and using the most appropriate raw materials.

Third, through time the variety of stone tool forms increases dramatically. As we saw at Olduvai, the earliest industries consisted of only a few basic types of tools dominated by choppers, and supplemented with a variety of expediency tools such as sharp flakes that were likely the by-product of chopper manufacture. As we progress through time to the Early Acheulian, the variety of tool types increases slightly. In the Middle Paleolithic, the variety of tool types is staggering. This period is typified by more highly refined tools manufactured for very specific purposes although the basic technology remains somewhat crude. The Upper Paleolithic continues the trend with very task-specific tools being manufactured on highly standardized blanks – the blades and burins as well as the composites.

Fourth, there is a trend through time for producing more cutting edge per unit of raw material. In the Chopper-Chopping Tool and Acheulian industries, one core tool and perhaps a few usable flakes could be manufactured from a single pound of raw material. In the case of the Acheulian Handaxes, the result was a very useful multipurpose tool that had a longer sharp edge for the given weight of the implement. In the Middle Paleolithic, with the adoption of the Levallois and especially the Disk Core techniques, core tools were largely replaced by flake tools made from prepared cores. About ten times as much usable cutting edge could be produced from the same amount of material used to make an Acheulian Handaxe. The trend culminated in the Upper Paleolithic with the development of Blade technology. Using the prismatic technique, roughly 100 times the amount of useful cutting edge could be produced from the same quantity of raw material.

Fifth, the increasing refinement of stone tools was accompanied by increases in the complexity of the process of manufacturing them and in the investment of time and energy that each tool represented. For example, a usable Acheulian Handaxe could be made with 25 well placed blows in one step. That process would probably take only a few minutes. An Upper Paleolithic blade knife would take up to 250 flake removals in nine fairly complex steps! While raw material was being used more efficiently, the tools were taking longer to manufacture because of the necessary additional steps required to use the material more efficiently. Part of this process also involved a change in the role that the stone tool played. Where initially the stone tool was the tool, in the Upper Paleolithic the stone tool was becoming just a part of a more complex compoundtool adapted to a very specific task. A compound tool such as a hunting spear would have a stone point attached to a hardwood foreshaft, that was in

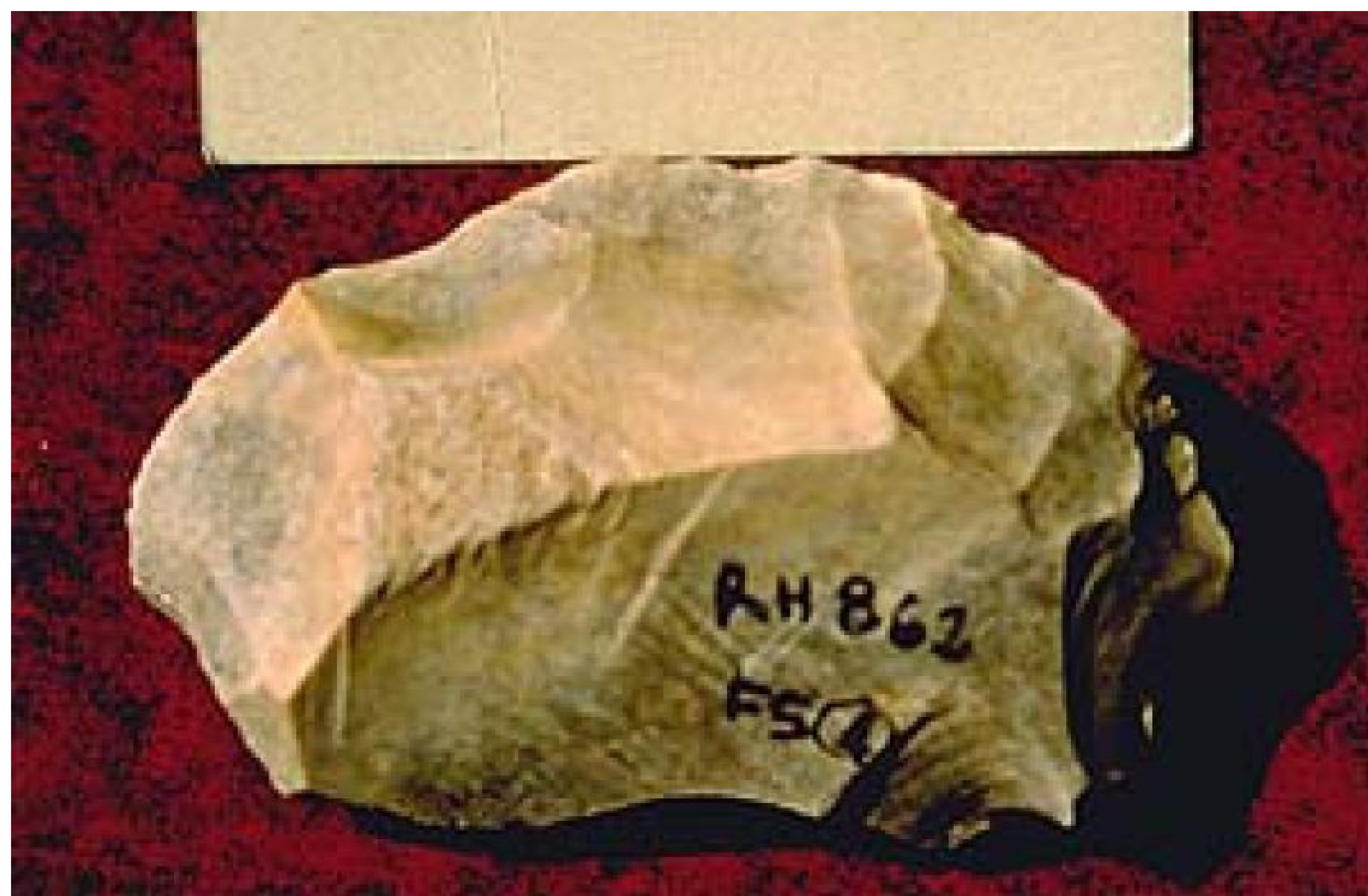
turn socketed into a main shaft, that was in turn hooked with a throwing stick.

All of these general trends are readily apparent in the archaeological record, and are recorded by the stone tools and production debris left behind. Certainly, these phenomena are interesting in and of themselves, but their real importance lies in the fact that they are clues, clues to fundamental changes in human behavior through time. And, this is the gist of prehistory.



V.2. In Search of Stones:

Research Work in Paleolithic of Pakistan



The history of Paleolithic research in Pakistan is a tale of almost two centuries' worth of painstaking work, accompanied with a sense of venture and often aided by luck.

Some of this work was an offshoot of the prospecting for oil and gas but some was truly archaeological in intention and scope. This rich mosaic of adventures and misadventures have been discussed by many archaeologists in connection with the description of individual sites or regions but a comprehensive story is still missing. We attempt to review here what is known and try to weave a story that may serve as a window to the world of chance discoveries and painstaking detective work.

Research Work in the North: Robert Foote is credited for the initiation of Paleolithic studies in South India in the mid nineteenth century but in Pakistan these studies began with de Terra and Paterson some half a century later. The first significant archaeological finds related to the Early Stone Age of Pakistan are from the north of the country. Among the early researchers who worked in Pakistan, Swynnerton was perhaps the first, in 1880, to illustrate a Paleolithic artifact from Tandiani, near Abbotabad in the northwest of Punjab. This was a triangular flake artifact which he called a "Paleolithic celt". By the way, Rev. Swynnerton was the first to put in writing the Punjabi forklore of Raja Rasalu and published it in 1884. Somewhat later, a geologist by the name of Wadia, described the geology of northern Punjab and Kashmir and mentioned some 'factory sites' near Gurha Shahan

besides G.T.Road near Rawalpindi. Then, in 1929-30, a surface collection of some 115 artifacts was made by Todd near Pindi Gheb on Sil river.

The modern phase of Paleolithic studies in Pakistan began in the 1930s when, in 1935, Joint Yale-Cambridge Expedition arrived under the leadership of Helmud de Terra, assisted by a wellknown prehistorian, anthropologist, and philosopher, Teilhard de Chardin, and a geologist by the name of T.T.Paterson, to undertake geological and archaeological work in Kashmir, Soan Valley in Pothwar, and upper Salt Range, from where they collected a large number of bones and stone artifacts. Notwithstanding the earlier work, the study of the Paleolithic of Pakistan owe its origin to these geological surveys. These were attempts to go beyond the succession and distribution of artifacts and consider the issues of related environment and geochronology. The most significant publication of this period was *Studies on the Ice Age in India and Associated Human Cultures* by Helmud de Terra and T.T.Peterson in 1939. This was based on their work in collaboration with Teilhard de Chardin, from Kashmir to the Salt Range, with a detailed focus on the Soan river valley, a smallish tributary of the Indus.

From the previous work in the Kashmir Valley by Danielli and de Terra's own in the foothills of the Himalayas, it was known that the Kashmir Valley had witnessed a series of glacial and interglacial events. It was therefore possible for them to trace a succession of glacial periods in the geological deposits of the lower slopes of the Himalayas of the Kashmir and northern Punjab region. During the glacial times, among other things, huge boulders were carried down the Valley and they had been found in the Soan Valley of the Pothwar region in the North of Punjab. By a careful mapping and study of glacial geography of the Kashmir Valley and the Pothwar plateau, de Terra and Patterson tried to correlate the geological events in Kashmir with the sequence of deposits in the Soan Valley. This stratigraphy played an important role in understanding the activities of early humans during this long period of evolution. Some of the conclusion reached by de Terra and Paterson were laster questioned but the basic premises remain intact.

In the course of their explorations of the Kashmir valley, the foothills of the Himalaya, and the Pothwar plateau, De Terra and his associates identified stratified Stone Age industries which were different from the Acheulian handaxes and cleavers known to archaeologists from other areas of the world. They named them *Soan.* Given the Pleistocene temporal context of the Soan tools, it was recognized that the two distinct traditions, i.e., the Soan and Acheulian, were contemporaneous. Besides, they obtained some other tools that neither belonged to the Acheulian tradition nor to the Soanian. For lack of any definite identification, they named these tools *pre-Soan.*

The de Terra-Paterson work is very significant because it went beyond paleoclimatic correlations attempted by of L.A.Cammiade and M.C.Burkitt near Madras in 1930 and introduced a geochronological scale on the European model. Moreover, having established a geochronological scale for its main area between Kashmir and the Salt Range, it extended the framework, through archaeological comparisons, to include the Narmada valley in central India and the area around Madras in the South. As Chakrabarti has noted (32), the point is not whether they were successful or even logical in their quest. What is relevant is that they were believed to be successful and logical till the 1980s when scientific basis of their groundwork was found to be wanting even in the context of the Pothwar plateau where they primarily worked. Thus, it was a dominating influence in the archaeological research in Pakistan for a long time, and it is worth knowing, even at this chronological distance, what the work meant.Basically, what they did was to postulate the existence of

a number of tool-bearing terraces along the Soan river and correlate them to the already known Quaternary glacial cycle in Kashmir. This correlation is summarized in Table 1. Further, a complete parallelism was assumed between the Himalayan glacial cycle in Kashmir and the Alpine glacial cycle in Europe so that there was no difficulty in understanding the Soan valley succession of stone tools in terms of a global geochronological perspective. While de Terra and Patterson were prospecting in the Pothwar Plateau, another geologist, Morris by name, was conducting geological studies at Khasor and Marwat Kundi in the Pashtun Country in the northwest of Pakistan. He reported the finds of three handaxes of Acheulian tradition.

Movius (1949), a prominent prehistorian of the time, did not conduct any field work in Pakistan or India, but relied on the data of de Terra and Patterson. He summarized their work, with some additional information from Morris at Marwat Kundi and that derived from collection at Peabody Museum. Movies re-classified the Pothwar artifacts into chopper-chopping tools of Soan tradition, which he thought belonged to Paleolithic pebble tool cultures of south and southeast Asia, and handaxes of Acheulian affinity, which had western similarities. Noting that the two assemblages occurred in different frequencies in southeast and eastern Asia than in India and Pakistan south of the Salt Range, Movius conceived an imaginary line (Movius's line) drawn as a diagonal across northeastern India to separate what he regarded as a technologically ‘isolated backwater’ of eastern Asia from the rest of the continent where handaxes were predominant in the Acheulian lithic tradition. This was a useful generalization about the spread of lithic culture among early human populations or about the dispersal of humans themselves in Eurasia. Movius’s work thus helped a lot to introduce the Paleolithic archaeology of South Asia to academicians and prehistorians of Europe and America. The Movius visualization, however, quickly came under scrutiny and the issue is still under lively discussion.

Following de Terra and Patterson, no notable Paleolithic studies were conducted until 1954, when an Italian Expedition to Karakorum Mountains, headed by Graziosi, arrived to investigate ancient routes between Pakistan and China across the Karakoram and the Pamirs. Graziosi served as a prehistorian to this expedition. He revisited some of the de Terra’s and Paterson’s sites in the Soan Valley and discovered a few more Paleolithic sites such as Morgah, Gola, and Khasal. Contrary to de Terra and Paterson, he hypothesized that SoanAcheulian tradition were not separate but represented one and the same tradition. His interpretations were based on surface collections from Morgah and other sites near Rawalpindi, where pebble tools and handaxes were found together. Graziosi found flake implements mixed with pebble-tools, handaxes, and cleavers, with no site containing tools of only one industry. He also did not find anything which could be called ‘pre-Soan’. The tool drawings and photographs are excellent, but report lacks stratigraphic details, artifacts’ statistics, and adequate location map of sites.

In 1962, Paterson, assisted by Drummond, tried to reclassify and rearrange some of the Paleolithic collections and published their analysis in the form a small booklet under the title *Soan – the Paleolithic of Pakistan*. They proposed a new chronology and introduced a few new names. Paterson arranged the collected stone tools into three separate categories, one consisting of handaxes, one in pebble tools of Soan tradition, and one of large flakes from within the top layers of the Boulder Conglomerate, attributed to a distinct Pre-Soan phase. He implied that Pre-Soan flakes had no typological connection either to Acheulian or Soan tradition. In spite of some drawbacks, it was the first comprehensive study of Paleolithic artifacts from northern Pakistan. It laid the foundation of Paleolithic archaeology of Pakistan.



Area of intense research in the Paleolithic past of the subcontinent

Salim conducted research in 1974 near Milestone 163 of de Terra's sites and reported several Paleolithic sites. Other areas included Margala Hills, Sil Valley, the Salt Range and the area around Morgah on the Soan River. F.A.Khan, in collaboration of Ranere, re-excavated Sanghao Cave with detailed stratigraphy and uncovered more quartz artifacts and animal bones. In 1976, Stiles, in collaboration with the Survey of Pakistan and Peshawar University, conducted fieldwork on the Siwalik deposits in northern Pakistan. He developed a novel stratigraphy based on paleomagnetic chronology and drew some conclusions, some of which are still controversial. He proposed to drop the fourfold glacial chronology of de Terra and Paterson in favor of one based on biostratigraphy, correlated paleomagnetic columns, and if suitable material is available, radiometric dating. He also called into question the existence of pre-Soan and early Acheulian industries, ascribing these tools to a

Table 1. The Soan Valley Sequence (after de Terra and Paterson, 1939)

T-1: Redeposited Boulder Conglomerate – 2nd glaciatial; Early Soan Industry of pebble tools classified into A, B, and C groups, with flakes. Found in the same T-1 but at separate localities, is the handaxe complex of handaxes, cores and flakes

T-2: The lower deposit of 'Pothwar basal gravel' with Late Sohan 3rd glacial; A industry (pebble tools associated with a greater number of flakes including Levallois flakes or flakes obtained by 'prepared core technique; the upper deposit of 'Pothwar loess' with Late Sohan B industry (mainly a flake and blade industry).

T-3: Redeposited Pothwar silt with evidence of a mixed pebble tool and handaxe assemblage called 'Chauntra Industry' after the name of the place where it was found. This is the only site where such a mixed assemblage has been found - 3rd glacisal

T-4: Pink silt, sand,gravel' with 'Evolved Sohan' industry, found at Dhok Pasthan - 4th glacial; This industry contains pebble tools, discoidal cores and flakes.

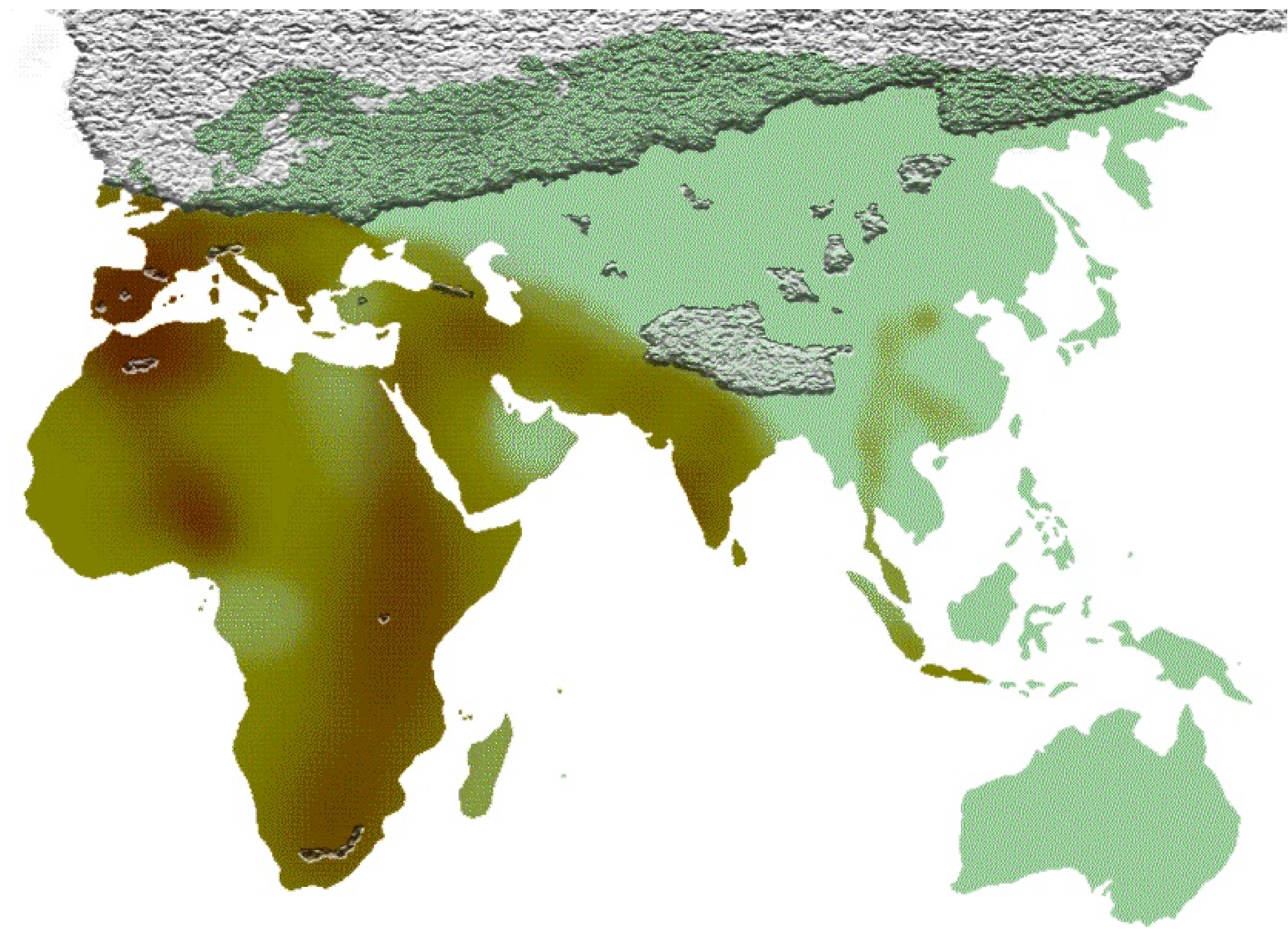
T-5: ‘Post-glacial silt’ – no artifact reported.

natural origin. He also argued that the early Soan industry could be a ‘facies of the Acheulian or a product of sampling bias of Acheulian surface scatters’. According to him the late Soan industry was Middle Stone Age/Middle Paleolithic. By questioning the validity of de Terra and Paterson’s four-fold glacial classification Stiles, in fact, provided a bridge to the successful work of H. Rendell, R. Dennell, and others who discarded the glacial classificatory scheme altogether.

During the early 1960s, a report of Paleolithic artifacts at Jalalpur in the Salt Range was made by Marks. He reported some artifacts of Early Soan type, found in a conglomerate composed of quartzite material. Although no illustration of artifacts is given, he compares some of his tools with those of de Terra and Paterson, identifying them as pebble flakes. In 1964, a brief survey was conducted in Pothwar, particularly in the Soan Valley and Haro basin, by Elden Johnson from the USA. He discovered several cave rock shelters in Pothwar, notable among them being Khanpur cave with microlithic artifacts. This decade marked a new era in Paleolithic research in Pakistan. Johnson published the results of his excavation at Mohra Battan and three other similar sites of the area in 1972 . He described choppers and flakes of the late Soan industry.

In the 1970s the pace of archaeological research has been maintained, even if the number of excavations and archaeological surveys has not been as great as it was during the 1950s and 1960s. This is due in part to changing economic circumstances and in part to changing methods and approaches. It is worth noting that a number of surveys, even major investigations, from the Paleolithic period are as yet unpublished, or only partly published. An outstanding example of this fieldwork is that of F.A.Khan which he undertook in the lower Sindh. Many smaller collections, some of crucial interest from one point of view or another, remain unpublished, and some - one fears - may never see the light of the day.

The British Archaeological Mission arrived Pakistan in late 1970s and conducted extensive archaeological surveys in the Pothwar region. Their field research made it abundantly clear that the picture of the late Pleistocene and early Holocene sequence put forwarded by de Terra and Patterson in the 1930s required radical revision. This was espe



Movius Line: Acheulian tools are found in areas shown above in darker shade. The areas shown in green are
devoid of such tradition. Northern Pakistan, especially Pothwar, lies on the borderline.

cially important as their work formed the basis of much discussion and of fieldwork on the geomorphology and Pleistocene geology of northern Pakistan ever since. Revision was particularly necessary from archaeological point of view as Paterson's discussion of the stone artifacts, found there in such abundance, claimed to show that there was a general correspondence between their physical conditions, typology, and technology, and their position in the terrace sequence. From this he postulated a number of minor sub-divisions, or stages, for the Soan industries, in addition to a major cultural division into Early and Late Soan.

Through their surveys in 1980 and 1981 the members of the British Archaeological Mission to Pakistan showed that the nature of such terraces as they are in the valleys of the Soan and other rivers that cross the Pothwar plateau had littler direct relationship to those of the Himalayan valleys. Some of the so-called upper terraces seem to be associated with the formation of the plateau rather than the eroding action of the rivers. This work obviously implied that the Paleolithic sites too must be seen in relation to the building of the plateau as a whole. Therefore, both the geological and the archaeological sequences constructed by de Terra and Paterson were set aside, and other means were searched for working out sequential relationships and dating individual sites and cultural phases. The

impact of de Terra and Paterson's research was, however, so strong that their sequential picture persisted for a long time; it still finds a prominent place in archaeological textbooks of India and Pakistan.

Among the most recent research efforts in Pothwar is that of the British Geological Mission in Pakistan in collaboration with the Geological Survey, Department of Archaeology, and various academic institutions of Pakistan. These studies, primarily conducted by Rendell and Dennell, are important. They, as the members of British Geological Mission, studied Pleistocene deposits and excavated Riwat, an Early Paleolithic site. Rendell and Dennell's work later came under much criticism for various reasons, first of all for their ruthless criticism of de Terra's four-glacial chronology (calling it 'obsolete') "without even paying a cursory visit to the glaciated area of the region, for focusing only on a few sites, for borrowing paleomagnetic dates from Reynolds and showing as if these dates were arrived at by them, for prematurely proclaiming a major discovery of a 2 million years old artifact from quartzite conglomerate bed near the G.T. Road sites, and for seeking public fame at the expense of the academic discipline they were supposed to serve", as one of his critiques complains. Dennel and associates were, nevertheless, later vindicated for their unconventional daring and their work is now highly regarded even by those who were earlier ruthlessly criticized by Dennell.

Rendell and Dennel specifically looked for stone artifacts which came from securely datable geological strata. Their efforts were awarded when in 1983 they found the first stone tools ever reported from localities near Jalalpur and Dina. This area was already surveyed and paleomagnetically mapped by geologists from Dartmouth College and Peshawar University and thus was possible to date the artifacts. Rendell and Dennell recognized the tools as handaxes, and dated them to a period between 0.5 and 0.7 million years ago. Rendell also produced a series of TL dates on Pothwar loess ranging between 170,000 and 18,000 years ago and this is probably their most significant contribution to the Paleolithic of Pakistan.

Instead of imposing a terrace sequence on the landscape and offering a set of unrelated industries, Rendell et al. related their admittedly limited number of finds to a secure and well-placed stratigraphy between 2.1 million and 18,000 years ago. What is also interesting is that they found no reason to argue that the paleolithic tradition of this area was dominated by a dichotomy between a pebbletool tradition and a handaxe tradition, considering the way the pebble tool tradition or the so-called Soanian tradition of de Terra and Paterson was given a distinct cultural tradition in South Asian archaeology, with infinite discussions on the ramifications of this tradition in the prehistoric archaeology of both Central Asia and peninsular India. Instead, "We see no reason to accept Paterson's assertion that there were two independent traditions of handaxe and flake-users in the Punjab during this time" . This opinion was also given support by Salim after the finds of Acheulian handaxes, cleavers, etc. in the Upper Siwalik Conglomerate in the Gurha Shahan area of Rawalpindi.

The contradiction between the position of Rendell et al and that of de Terra et al is not, however, as big as it is generally made to be by some archaeologists. At the sites of Adiala and Balwal, de Terra and Paterson found handaxes with Soan tools of early and late phases in similar horizons, thus making it difficult for De Terra and Paterson to distinguish the two traditions temporally and stratigraphically. Consequently, they observe: "It is interesting to note the parallel development in the Punjab of the Soan flake and pebble industries, alongside the Abbevillian-Acheulian complex". These two distinct cultures have been found in contact at Chauntra also, where handaxes of late Acheulian

type are found associated with cores and flakes of late Soan age. The specimens from this site, and from others, unfortunately, are too few for the results of this contact to be determined. In spite of the controversies that the Rendell and Dennell's work has generated, their investigations are pivotal to the paleolithic studies of northern Pakistan. They go a long way to the explanations of the paleolithic past of the Pothwar plateau, just as those of de Terra and Paterson did several decades ago.

By the close of the 1970s, it was widely believed by South Asian prehistorians that the earliest time frame for Paleolithic tools in the subcontinent was the middle Pleistocene. Furthermore, notwithstanding the local developments of some features of Acheulian tools within South Asia, there was no evidence to support the notion of a South Asian Oldowan stage from where the Acheulian tradition could have arisen. This means that the appearance of stone tool-making technology in South Asia must have been a result of some kind of cultural diffusion from the West. Absolute dating remained baffling, except for those prehistorians who continued to rely upon the glacial sequences devised by De Terra and Paterson for Kashmir, the Siwaliks, and the Pothwar plateau. There was a definite reluctance in some quarters to abandon Movius's projected dates for pebble tools, which he linked to the middle Pleistocene pebble choppers of southeast Asia.

The de Terra and Paterson data, as well as the Movius correlations, suggested to some investigators that hominins had reached peninsular India by the time of the early phase of the third interglacial, appearing as early as 250,000 years ago. This timeline was designated as the pre-Soan period of the second interglacial in the northwestern sector of the subcontinent. The discovery of Acheulian handaxes and scrapers by Dennell at Jalalpur and Dina and establishment of their secure dates for the presence of hominins in South Asia to 500,000, possibly 700,000, years ago, changed the situation radically. The discovery at Riwat, thanks again to the members of the British Archaeological Mission to Pakistan, further extended the timeline for the first appearance of hominins in the Siwaliks to almost 2 million years. This is a fascinating story, and for its utmost importance it is recounted separately elsewhere in this book.

The Discovery of the Sanghao Caves: In 1962, Hassan Dani founded the Department of Archaeology at Peshawar University and started to investingate many historic and Buddhist sites. During one of his expeditions he came across the Sanghao cave, a Middle Paleolithic site in Mardan District, which he excavated the in the early sixties and showed that it had *ca.* 4.6 m deep occupational deposit with 12 layers, each layer being separated from the previous one by an ash-and-charcoal line. His name is now inextricably linked to the Paleolithic discoveries in the Peshwar plains

Dani published a preliminary report in 1964. It was obvious that the site could contribute significantly to our understanding of the prehistory of Pakistan during the Late Pleistocene. Here for the first time in Pakistan was a stratified habitation site that was apparently in use for twenty to thirty thousand years. This discovery lead to the finds of several other rock shelters in the same area and lately in the Bajaur Agency of the tribal area.

The Paleolithic Research in the Dry Zone: The story of Paleolithic research in the Dry Zone of Sind and Lasbela is as interesting as that of the North. This story is still unfolding despite the fact that all potential areas of Paleolithic research are rapidly being destroyed by indiscriminate mining by the cement industry and by the encroaching dry farmers. Of the early investigators of this Dry Zone, along the margins of the Thar Desert, we must give first place to Colonel James Tod (1782-1835). Tod first went into this area in 1806, attached to the embassy sent to the court of Siddha. It was Tod

who largely made available the first useful maps of Rajasthan in India and the area east of the Indus. Other remarkable journeys of exploration and survey were made very shortly afterward. Sir Alexander Burns, for example, visited Sindh and the Punjab in 1830 and wrote a series of informative and perceptive accounts of the landscape and some geological formations. He published papers on such topics as the effects of earthquakes on the Indus and the development of the Rann and made some early observations of the Thar sand dunes. In the 1860s Sir Batrtle Frere (1815-84) undertook travels in the Desert as part of his work as Commissioner in Sindh.

La Touche worked for the Survey of India from 1881 to 1910, and he wrote extensively on glaciation in northern Pakistan and the geology of western Rajasthan. However, prehistoric stone tools were not reported from this region before 1866, when J. Evans, writing in the Geological Magzine, briefly mentioned (1866) some artifacts found at Rohri in Sindh. This was probably the first mention of this important group of Paleolithic sites in Pakistan. Unfortunately it is not clear whether Evans was aware that earlier Paleolithic material was also present. These were of chalcolithic style of manufacture, and it was not until the 1930s that paleolithic tools were recovered, a consequence of de Terra and Paterson's survey of Sindh.

W.T. Blanford, who came to India in 1855 as a professional geologist, was probably the most productive of all, writing 175 published papers and contributing the largest part of the *Manual of the Geology of India,* which was later enlarged and published as the *Encyclopedia of Indian Geology,* a two volume set, in collaboration with H.B. Medlicott. His 1877 paper on the *Geology of Western Sind* is a classic and makes many fine observations on the landforms and history of the area. A brief description of Harappan blade cores and flakes from this area was included in his monograph (1880), and these were again referred to by Cousens (1929) and Marshall (1931). de Terra (1939) visited the Rohri Hills in 1938 and described the Harappan blades and blade cores, and earlier material including Middle- and Upper Paleolithic cores, flakes, blades and scrapers. He concluded that while some of the material he had seen was Harappan, the other group of artifacts, consisting of cores of various forms, flakes, blades and scrapers, which he collected, were of earlier time periods, and ended up by saying "the fact that no sharp dividing line can be drawn between the. . . groups suggests that there has been continuous occupation of the sites, covering, in all probability, only a relatively short period of time".

Sindh plains and the Thar received little further attention from geologists or prehistorians with leanings to the Stone Age until after the Partition in 1947. Some Paleolithic research in the Thar was initiated by the Archaeological Survey of India during the early fifties. A little later, Archaeological Department of Pakistan also started to take interest in the Paleolithic of the region. A major study was



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Professor A.H. Dani

that of Muhammad Rafique Mughal who undertook an extensive survey of Cholistan, which is a part of the Thar Desert in southern Punjab. He later publish this excellent study in a very handsome book, *Ancient Cholistan.* During the same period, F.A.Khan (1957) excavated the Harappan settlement of Kot Diji but makes no reference to any Stone Age material in the area.

Bridget Allchin from Cambridge University did some observational work with H.Dani at the Shangao Cave in the Peshawar Valley but her major contribution to the Paleolithic of Pakistan comes from her work in the Arid Zone of Rajasthan and Sindh in the seventies. These findings she summarized in her

books, *The Birth of Indian Civilization* and *The Rise of Civilization in India and Pakistan*, which she authored with her husband Raymond Allchin. *The Prehistory and Paeolgeography of the Great Indian Desert*, coauthored with Guidie and Hegde, is a detailed exposition of this work. Their work centered upon the development of early man during the latter part of the Pleistocene in the area between the Indus River in Pakistan and the Aravalli Hills in India.

In January 1975 Bridget Allchin made a brief survey of the Rohri Hills which was far from being exhaustive, but enabled her to make certain

observations, and to carry the study of the artifacts and working floors further than earlier observers had done. She discovered several Paleolithic sites located mainly at the northern and southwestern ends of the sprawling hills and, based on the size of the sites, suggested that in this region early humans worked in large entities long before the Indus cities of 2500 B.C. Bridget Allchin and her associates

also visited Milestone 101 (Ongar) near Hyderabad and described her finds in *The Prehistory and Paleogeography of the Great Desert* in some detail.

Further work in the area was initiated in 1986 by P. Biagi and M. Cremaschi who reported early Paleolithic tools around Unnar. At a site called Red Hill they found evidence of environmental conditions in the geological deposits and soil profile. Further explorations were conducted in the 1990s. At Ziarat Pir Shaban they showed the presence of Acheulian industry in the region. Biagi spent more than a decade in doing Paleolithic research in Sind and is presently the foremost authority on the subject.

Wengle, a member of the French Mission excavating at Neolithic Mehrgarh under Jarrige, studied quaternary geology of Bolan basin. He reported Middle Paleolithic artifacts including Levallois flakes from a surface site among pebbles near the Bolan River. The seven artifacts, which he illustrated, are flakes, some retouched. A little later, Kazi engaged himself in the investigation of some sites at Rohri Hills but did not publish his work beyond a seminar given at S.A.L. University at Khairpur in 1992. Farid Khan, in collaboration with Knox and Thomas, has been busy for a number of years in Bannu Basin on Mesolithic, Neolithic and Bronze Age sites. In 1986 they reported Paleolithic artifacts near Tarakai Nala . They also reported later middle Paleolithic artifacts from surface sites at Dre Ghundheri, also in Bannu basin.

The story of Paleolithic research in Pakistan does not end with the work of the Brititish Archaeological Mission to Pakistan, the retirement of Biagi, or the death of Dani. It, however, takes an ugly turn: the scarcity of funds for undertaking any fresh research projects, wide-spread corruption at the Pakistan Archaeological Department, an absolute absence of academic interest in Stone Age archaeology at the institution of higher learning which contributed so significantly in the past, and evaporation of foreign interest, are a common them of the present day.

Paleolithic Research in India: The history of Paleolithic research in India is rich, starting from Robert Bruce Foote (1834-1912). Foote was a British geologist and archaeologist who conducted geological surveys of prehistoric locations in India for the Geological Survey of India. In 1863, he discovered the first Paleolithic stone tool (a hand axe) near Chennai in South India. This pushed back the antiquity of humankind in the Indian subcontinent and placed India on the world map of pre-history. It was a remarkable find because the stone tool, used by hunter-gatherers, was presumably

more than 500,000 years old. Following Bruce Foote, interest became focused upon the Stone Age of many parts of India and collections of stone artifacts were made all over the country, many of which found their way into Indian museums. It goes without saying that archaeologically India is not a monolithic region and most of it does not have much relevance to the paleolithic of Pakistan. Since we are primarily concerned here with the research related to the Greater Indus Valley, our point of reference to the east is in the borderline areas of India.

At Pahlgam in Kashmir, 65 km east of Srinagar, and at a half dozen sites in the Punjab of Pakistan, pebble tools and large flakes were reported as recovered from the Boulder Conglomerate. The lithic specimen from Pahlgam is a crude hand axe found at the point where the Boulder Conglomerate converges with a brownish silt, whereas in the other localities these kinds of tools were found in gravels or on open terraces assigned to the third interglacial. The dating, however, remained elusive till in 1971. Sankalia suggested an early Pleistocene (first interglacial) date for the Pahlgam handaxe and other tools he found on the Liddar river in Kashmir. These consisted of a quartzite scraper, borers of quartz schist, a rectangular quartzite core, and a handaxe-cum-chopper. R. V. N. Joshi and his associates concurred that these were the earliest signs of human habitation in India and the Indian-held territory of Kashmir. The dates they ascribed to the tools ranged from the second glacial to the third glacial.

By 1978, Sankalia had modified his interpretation of the antiquity of the handful of tools under consideration, favoring the view that faunal and geological associations with tools in the river valleys of Kashmir and elsewhere may be broadly dated to the middle Pleistocene or to an early phase of the late Pleistocene. He placed the closing phase of the lower Paleolithic tools at around 50,000 years ago whereas earlier phases might extend to 100,000 years ago. Since the oldest Boulder Conglomerate



Cholistan Desert also locally known as Rohi) sprawls thirty kilometers from Bahawalpur, Punjab, Pakistan and covers an area of 16,000 km². It adjoins the Thar

desert extending over to Sindh and into India.

can be dated to 0.5 million years ago, the earliest tools from Kashmir must be considerably younger. Thus, after a brief period of excitement, the stone artifacts of ‘great antiquity’ from Kashmir were downgraded to be of more recent origin.



The Dry Zone of Sind and the Thar and Cholistan Deserts are of immense Paleolithic interest. This area has been explored by Bridget Allchin, F.A.Khan, M.Rafique

Mughal, and lately by Paulo Biaggi.

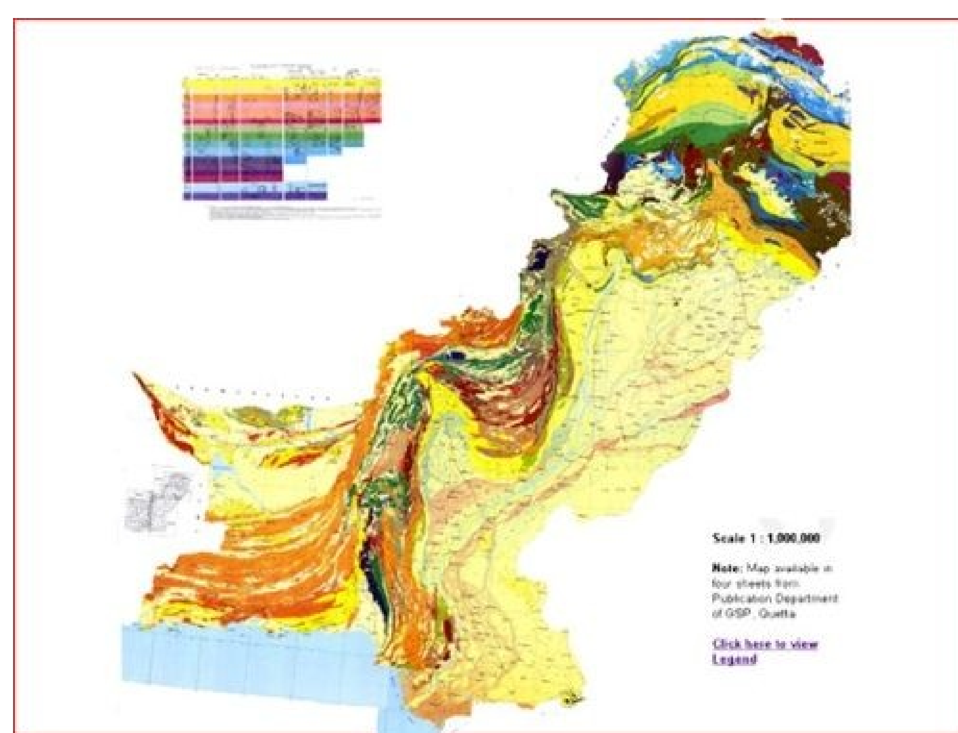
In 1975 B. C. Verma recorded the occurrence of crude handaxes, choppers, flakes, and pebble tools embedded in a rich fossiliferous locality in the Pinjor member of the Upper Siwaliks at Kheri, Himachal Pradesh in North-west India. He asserted that some of the tools, which were extracted directly from the sandstone conglomerate bed, established their antiquity as early Pleistocene. In that same year, J. C. Sharma, who was searching for early hominin sites in the Indian Punjab Siwaliks, announced the discovery of pebble choppers, handaxes, cleavers, and large flakes in the Lower Boulder Conglomerate. As the tools were heavily rolled, Sharma concluded that they had been manufactured at a time earlier than the formation of their contextual deposit, that is, in the early Pleistocene. Furthermore, he suggested a local evolution of these tools within the region of northern Punjab, although he acknowledged their typological similarities to African and European forms. The association of handaxes of Acheulian tradition with chopper tools of a style identified earlier as a Soan specialty led Sharma to assert that many of the previous speculations of prehistorians about the antiquity of man in South Asia were on the verge of being overthrown. This, of course, generated a lot of excitement in archaeological circles working in India

The hopes of Verma and Sharma were shattered by the reevaluation of their evidence by G. C. Mohapatra and M. Singh, who recognized several localities where artifacts are found *in situ* in stratified horizons in the Chandigarh Siwaliks. These artifacts do not appear in the Boulder Conglomerate of the middle Pleistocene, and their antiquity is probably no earlier than late middle Pleistocene. The majority of artifacts they have found *in situ* were of late Pleistocene date.

Paleolithic Research In Afghanistan: Afghanistan has yielded cleavers, choppers, scrapers, and pebble tools through explorations undertaken by Dupree in 1974 on the shores of the Dasht-iNawar, a large lake bordering the Hindu Kush range in Ghazni province. The tool typology is lower paleolithic, but the specimens lack faunal associations and geological stratigraphic contexts. These

Afghanistan tools bear a close resemblance to Paleolithic tools of nearby Pakistan and to pebble tool and flake industries of central Asia. Stylistic similarities to the Ladizian tools of Iranian Baluchistan have been observed but faunal and stratigraphic data are absent. In all likelihood, these artifacts belong to the late Middle Pleistocene.

V. 3. Distribution of Paleolithic Sites in Pakistan

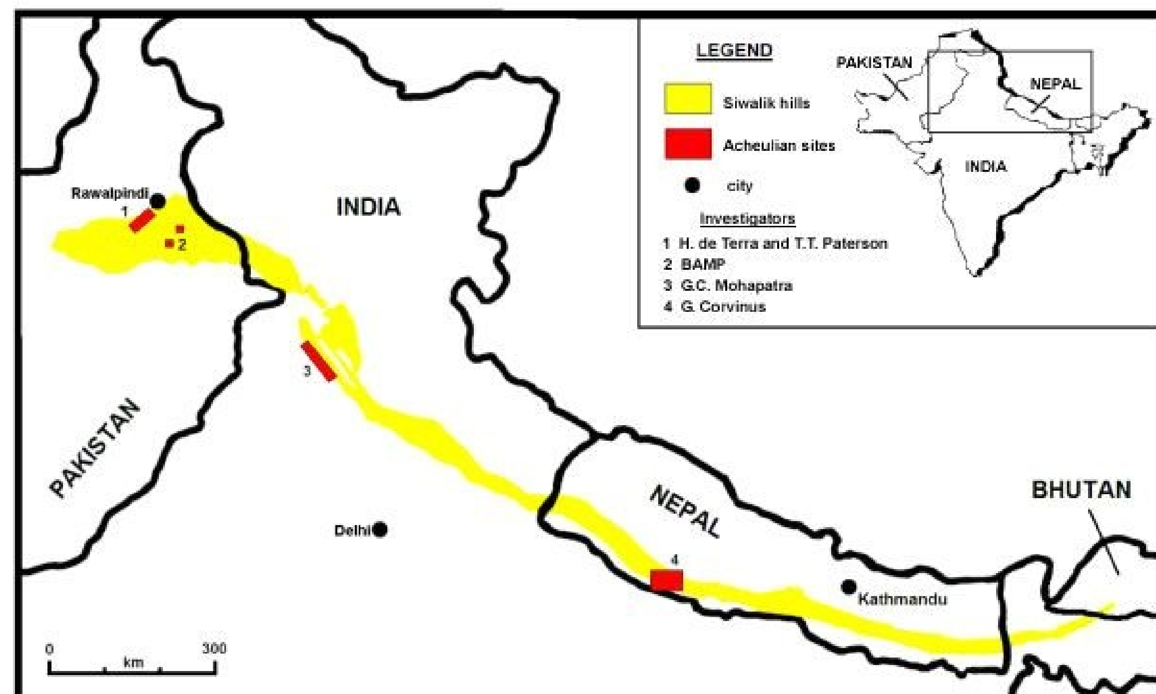


Pakistan is rich in Paleolithic remains. This is more evident in some areas than in others, but there is no major area that is without Stone Age sites of several periods. In some areas the stone tools are found in a profusion that is almost overwhelming. These sites are, of course, of utmost interest to us. Other areas, even if they are not that rich in archaeological remains, are of interest to archaeologists and prehistorians if nothing else than for reason that they have been explored somewhat more extensively than the others. These archaeological sites are of several kinds: habitation sites, either in rock shelters or in the open; factory sites associated with sources of raw material; sites that combine elements of both these functions; small concentrations of artifacts with or without an apparent specific character; open air sites in any of these categories subsequently covered by deposition of sand, silt, loess, etc. and seen in process of re-exposure; derived material in geologically stratified deposits, either in river terraces or deposits of detrital material; scatters or spreads of varying numbers of artifacts on old erosion surfaces; and isolated finds of single artifacts. All of the Pothwar sites of the Early Stone Age of Pakistan fall into this category. Two groups of cave shelters in Peshawar Valley and Bajaur Agency, respectively, provide examples of the Middle and Late Stone Age of Pakistan, several ‘factory’ areas in Sindh offer some excellent examples from the Early to Late Stone Age periods, and stray finds along the coast of Sindh and Baluchistan generally expose the technological nature of still later periods.

Stone Age sites vary greatly in nature and extent, and no two sites are ever exactly alike. Sites where people lived, temporarily or more or less consistently over periods of time, are the most obviously interesting category and have the greatest potential for yielding internal cultural and ecological evidence. But a more complete picture can be built up by considering all types of sites in a locality or a region, even if, in the first instance, their chronological relationships are not clear. By surveying all available evidence one can begin to work out the relationships of sites to each other and to the environmental setting. This is the basis of most Paleolithic studies and this is actually needed for looking into our distant past. In this chapter we shall try to convey something of this interest by giving a brief account of the geographical areas where Paleolithic sites have mostly been found and

put on record.

While Africa holds just claims today as the continent on which our earliest human ancestors evolved, the vast sub-Himalayan landmass offers scientists the challenge of discovering the evolutionary diversity of those human ancestors who moved out of Africa and into Asia probably more than two million years ago. Their settlement in the Caucasus, Central Asia, and northern Pakistan has been established by the recovery of very early Pa



Distribution of Siwalik sediments and associated Acheulian sites

leolithic tools, some of which go as far back as 2 million years. The early presence of hominins in Pakistan is indicated by the recovery of stone tools of great antiquity in the Pothwar Plateau and the Salt Range. It is also indicated in Sind, especially in the Rohri Hills area near Sukkar, the Milestone 101 (Ongar) area near Hyderabad, and the Las Bela plains in the westernmost areas of Sindh. Such an antiquity of man's presence is, however, not indicated by fossils finds. In fact, if we go only by the fossils record, the recovery of a middle Pleistocene fossil hominin specimen from Narmada valley to the East and partial human cranium from Afghanistan to the West may prove that the region was populated only by 300,000 years ago or even later. The presence of stone tools, however, tells another story.

Most of the Stone Age sites studied in Pakistan are of surface sites category. For reasons that are not clear at present, the Stone Age artifacts are only very rarely found in caves or rock shelters in Pakistan, in contrast to Europe and eastern Asia and to some extent India. Surface sites, mainly erosional, are common all over Pakistan but some of the most interesting and obviously more rewarding sites are factory or work sites in the Soan valley in the Pothwar Plateau in the north of Punjab, and Sindh where stone tools were made and other activities were carried on generation after generations from the very early days of human evolution to the dawn of civilization.These are usually places where suitable stone was available, to which people came and made their tools. They left quantities of debris and unfinished or broken artifacts which are of great interest to archaeologists as a means of understanding how the tools were made.
ers left them hundreds of thousands years ago, allowing us thereby to see how they relate to each

other and to make more detailed inferences regarding their use. This situation is more commonly found at sites of later periods, as we shall see in the case of the Middle and Late Stone Age in the Rohri Hills area of Sindh.

The following geographical areas find frequent mention in Paleolithic literature of Pakistan:

1) The Siwalik Hills, the Pothwar Plateau, the Soan Valley, and the Salt Range.
2) The fringes of the Peshawar Plains, especially in the Mardan district and Bajour Agency.
3) The Thar Desert, the lower Indus Valley, and the Las Bela plains.
In this section, we shall survey these areas and see what kind of Paleolithic evidence they offer for shedding light on the prehistory of Pakistan.

THE SIWALIKS, THE POTHWAR PLATEAU, THE SOAN VALLEY, AND THE SALT RANGE
The Siwalik Hills, the Pothwar Plateau, the Soan Valley, and the adjoining areas of the Salt
Upper, Middle, and Lower Siwaliks and their various formations with approximate ages (in million years ago)

SUB-GROUP	FORMATION	Corvinus & Rimal, 2001 (ma ago)	Prasad, 2001 (ma ago)
Upper Siwaliks	Upper Boulder Conglomerate	5.9 - ?	0.9 - 0.2
	Lower Boulder Conglomerate		
	Pinjore		2.4 - 0.9
	Tatrot		5.1 - 2.4
Middle Siwaliks	Dhok Pathan	7.9 - 5.9	10.8 - 5.1
	Nagri	10.1 - 7.9	
	Chinji	13.1- 10.1	
Lower Siwaliks	Kamlial	--	18.3 - 10.8

One of the problems in studying surface sites is that so much must have been disturbed over the course of time by floods, general erosion, deflation, the feet of passing animals and people, or by cultivation. Recent research has shown that even when artifact groups have been locally disturbed by any of these agents or simply by a general tendency to move downhill, as the great majority we see today probably have, they tend to stay together and retain their group character and much of their interest for the archaeologist. This situation is fairly common in the case of Lower Paleolithic sites in Pothwar. By contrast, there are sites where objects have remained precisely where their owners or usRange are of the utmost importance in the study of the Stone Age of Pakistan. It is in this region that we find the earliest evidence for the presence of humans in South Asia. The evidence comes in the form of stone artifacts which the early hominins of this area fashioned, used, and left behind for our musing. Some of the oldest occupational evidence may be of late Pliocene or Early Pleistocene age

(1) but most of the evidence is from the Middle and Late Pleistocene. All of this area is a topographic continuum as it derives its formation, one way or the other, from the same natural forces: deposition, tectonic uplift, and erosion. These deposits are one of the most comprehensively studied fluvial sequences in the world.
The slopes of these hills provide one

of the longest, best calibrated, and most detailed fluvial sequences of their age in the world. Because they are also (for the most part) rich in fossils (although not human), the Siwaliks are one of the best terrestrial faunal sequences in the world also, particularly for the Miocene. These hills have been the longest studied area in Pakistan. The first fossils were collected in the early nineteenth century, and the first monograph on Siwalik fossils was published by Falconer and Cautley as early as 1845. An immense amount of paleontological and stratigraphic research by officers of the Geological Survey of India took place in the British period; this was supplemented by the Yale Expedition (1934-5), which resulted in the discovery of the Miocene hominoid *Ramapithecus punjabicus* and the Pleistocene Soan Industry. Much paleontological research has also been conducted after the independence, of which the work by a decade-long work by the British Archaeological Mission to Pakistan was truly rewarding. A lot of work has also been done in the adjoining areas of India and Nepal and this bears some relevance to Pakistan. The Siwalik foothils, under the shadows of the Himalayas, is one of the most important archaeological region in Pakistan and it therefore deserves a special attention.

The Siwaliks: The Siwalik Hills, also known as the Outer Himalayas, are the southernmost and geologically youngest east-west mountain chain of the Himalayan system. These hills crest at 900 to 1,200 meters and have many sub-ranges. They extend 1,600 km from the northern Punjab and Kashmir eastward through Nepal extending as far as Assam. The Siwalik Hills are chiefly composed of mudstones, sandstones and coarsely imbedded conglomerates, and the formations which are derived from the Himalayas to the north during Middle Miocene to Middle Pleistocene times. They are bound on the South by a fault system called the Main Frontal Thrust, with steeper slopes on that side. Siwalik Hills are located within the political boundaries of Pakistan, India, Nepal, and Bhutan, and range between 6 and 90 km in width and, as said, span over 1500 km in length.

The sediment deposits, forming the Siwalik hills, were uplifted through repeated and intense tectonic regimes, resulting in a unique topographical entity. These sediments are divided stratigraphically into the Lower, Middle, and Upper subgroups, which are further divided into individual Formations that are all laterally and vertically exposed today in varying linear and random patterns. Paleoarchaeologists are primarily concerned with the younger sediments, the *Upper Siwaliks*, of whose ages are concurrent with Pleistocene hominin dispersal and occupation throughout West Asia, South Asia, and Southeast Asia.

The Upper Siwaliks comprise three stages - the Tatrot, Pinjor, and Boulder Conglomerate. The Tatrot is the oldest among the Upper Siwaliks and the Boulder Conglomerate is the youngest, while the Pinjor lies in between (1). The boundary between the Tatrot and Pinjor stages coincides with the Gauss-Matuyama palaeomagnetic boundary at *ca.* 2.5 million years ago (see Section I for details) and that between Pinjor and Boulder Conglomerate is generally taken as 1.0 million years ago (1). These stages were first defined as faunal zones. Unfortunately, the main way of dating Siwalik deposits before paleomagnetic and radiometric dating methods was by their fossil remains and this led to much confusion. The availability of paleomagnetic and radiometric methods of dating has

improved the situation quite a bit.

The Boulder Conglomerate is covered with Lei Conglomerate with the boundary between the two lying somewhere between 800,000 and 700,000 years ago. The Lei Conglomerate is, in turn, covered with loess and on top of it is tufa. However, not all of these depositional stages are found in every region of the Siwaliks and wherever they are found, they profoundly differ in their thickness. The timing of their deposition also varies throughout the Siwaliks. To complicate the matter further, these sedimentary deposits were uplifted through repeated and intense tectonic regimes, resulting in a unique topographical formation. This time-transgressive nature, therefore, does not allow us to recognize different deposits as marker horizons despite their intermittent, but conspicuous presence along the entire Siwalik range.

Two primary depositional formations of the Siwaliks, are of interest to us: the Pinjor and the Boulder Conglomerate. The former concerns us because it sheds some light on the origins and dispersal of early humans, the latter concerns us because it furnishes us a window to the cultural path which the evolving humans presumably took for their Paleolithic journey in the north of Pakistan. The Pinjor stage of the Upper Siwaliks lasted from the Late Pliocene (*ca.* 2.6 million years ago) to the early Middle Pleistocene (*ca.* 1.0 million years ago). Its deposits are often extensive in Pakistan, as in the Pabbi Hills, and are largely those from active or abandoned river channels. Isotopic studies of soil carbonates and fossil teeth of animals show that the northern part of the subcontinent was primarily a grassland environment, and had been so for at least 7 million years. Although plant resources are unknown, the fauna of the Pinjor Stage is known in some detail. It is in this stratum that a definite presence of some type of *hominin* is first noticed and it is in this geological formation that primitive tools made of split pebbles and large flakes were found. These early stone tools have no close relatives in any other part of Pakistan, or for that matter, anywhere in the subcontinent, but show a surprising similarity with the earliest stone tools found at Oldovai in East Afrca.

Boulder Conglomerate deposits form a major part of the Pothwar plateau. Some of the earliest relics of Stone Age in the world have been found here, with a probable antiquity of about two million years, but mostly belonging to a time period between 700,000 to 200,000 years ago. These crude stone implements recovered from the terraces of the Soan River in Pothwar carry the account of human grind and endeavors in this part of the world in the form of primitive looking, heavily rolled and abraded stone artifacts.

The Boulder Conglomerate Formation is, divided into Upper and Lower conglomerates, both being noticeably distinct units. They both comprise quartzite pebbles, cobbles, and boulders of varying size, type, density, and orientation. Although the matrix contains smaller nodules of other rock types, the quartzite was the most suitable raw material available to (and selected by) the hominin occupants of the region at the time. Boulder Conglomerate deposits provide a whole range of environmental evidence covering the last two and a half million years of human existence in northern Pakistan.

Notwithstanding the importance of the Boulder Conglomerate, a large number of archaeological sites that are of major significance for studying the hominin's cultural record through the middle Pleistocene are located in 'post-Siwalik' situations. Here, the term 'post-Siwalik' refers to sediments which have accumulated after the deposition of the Boulder Conglomerate, the youngest Siwalik Formation (3). These comparatively younger sediments are dispersed in intermontane valleys, on Siwalik hill slopes, and in association with Middle to Upper Pleistocene river/stream terrace systems.

Due to a high rate of ongoing erosion and neo-tectonic activity, Siwalik sediments have not yielded stratified Palaeolithic material of such integrity as known from other regions in the World. All documented Siwalik sites occur in varying geological contexts. Most of the findings occur in association with Upper Siwalik sediments and on erosional ‘terraces’ of the Soan river valley.

The Pothwar Plateau: The Pothwar Plateau, in the north of Punjab, is an extension of the Siwalik Hills. It is an elevated plain, a plateau, situated between the river Indus to its north and northwest, and Jhelum to its east and southeast. Its north is squeezed between the sub-Himalayan mountain ranges of Murree-Abbottabad with lesser Marhgala Hills at the height of 1200 meters. Its south is bordered by the Salt Range with major heights of 1054 meters near Pai Khel and 1522 meters at Sakesar with gradual decrease towards east. A basin is formed between this Salt Range and to the Mountain ranges of the north. In it are outcrops of rocks of Kala Chitta south of Attock, Khairi-Murat near Fateh Jang, the hills south of Hassan Abdal and sandstone ridges near Khaur. The entire plateau covers an area of about 400-500 sq. miles. This is indeed a large geographic area.

Besides the Indus and the Jhelum, there are other small rivers, admittedly less in water
reasons for this obscurity include both the inadequate definition of complexes The
Pothwar
Plateau
provides
associated with the upper Pleistocene in South Asia and the lack of solid dating a whole
content but decidedly more important historically.controls for those already defined. The case has perhaps been overstated by Bordes range of environmental evidence covering the last Haro, Soan, and Kanshi meander through its hilly
(1968 :200)-who recently noted that "Practically nothing is known about the upper
two and a half million years of human existence in
landscape. These rivers are fed by seasonal water
Palaeolithic in India or Malaysia" -for Sankalia (1964), Joshi (1964), Allchin
Pakistan. Some of the earliest relics of Stone Age in
streams, some of which are perennial. All these riv

(1963), and their colleagues have certainly added to the knowledge of the period with carefully documented descriptions of the Nevasian and Wainganga B flake the world have been found in the Pothwar region, ers and water streams are lifeline for this region, onindustries. with a probable antiquity of about two million years. the banks of these are situated several cities such

Sankalia sees the Indian Nevasian and the Pakistani Late Soan as contemporary
It is here that a definite presence of man or some
as, Attcock, Rawalpindi, and Jhelum. Several large
and as distinct industries but sharing an as yet undefined mutual influence type of *hominin* is first noticed and it is in this geovillages and towns flourish in this area, using the
(1962 :200). He wisely cautions against the fairly common but premature attempts
to seek wider affinities "between the Middle Stone Age culture and African logical area that tools made of split pebbles and syncline and flood-plain for agriculture. Most of the
(including the Egyptian) or European stone age cultures" on the basis of the limited
large flakes similar to Oldovai were found. This
area is, however, without water except that which data now available (1964:374). stone tool industry is known as the *Pre-Soan* indus becomes available in the form of some meager rain
Four Potwar archaeological sites that span the time period concerned are described briefly below. Tests were made at each of these sites

and, although the try, to indicate its chronological position before the in summer and still less in winter. resultant assemblages are very small, and the sites need excavation to provide fuller main series of Lower Paleolithic cultures in the valley of the Soan River. It is important to remember

A varied climate exists in Pothwar from the snow-peaked Murree hills to the moderate temperature in the Salt Range. Even in the foothills, the temperature sometimes falls to –2° C as far as in the Jhelum valley, while the temperature in the hot months may go up to 120° F. The maximum rainfall of 64 inches is recorded in the Murree hills but as we descend to the plains, it decreases to an average of 30 inches. An above-average rainfall produces lush vegetation and yields abundant crops of millet and maize. This is, however, not of any relevance to the study of the Stone Age because the climate has changed drastically.

The Soan Valley: Pothwar Plateau is largely known through the Soan River. It is a tributary of the Indus river and has given its name to a paleolithic stone tool industry which is essentially a pebble-based industry and supposedly a distinct entity, having more in common with the other pebble-based Paleolithic assemblages of central Asia, China, and southeast Asia than with the generally endemic biface lithic tradition of not merely

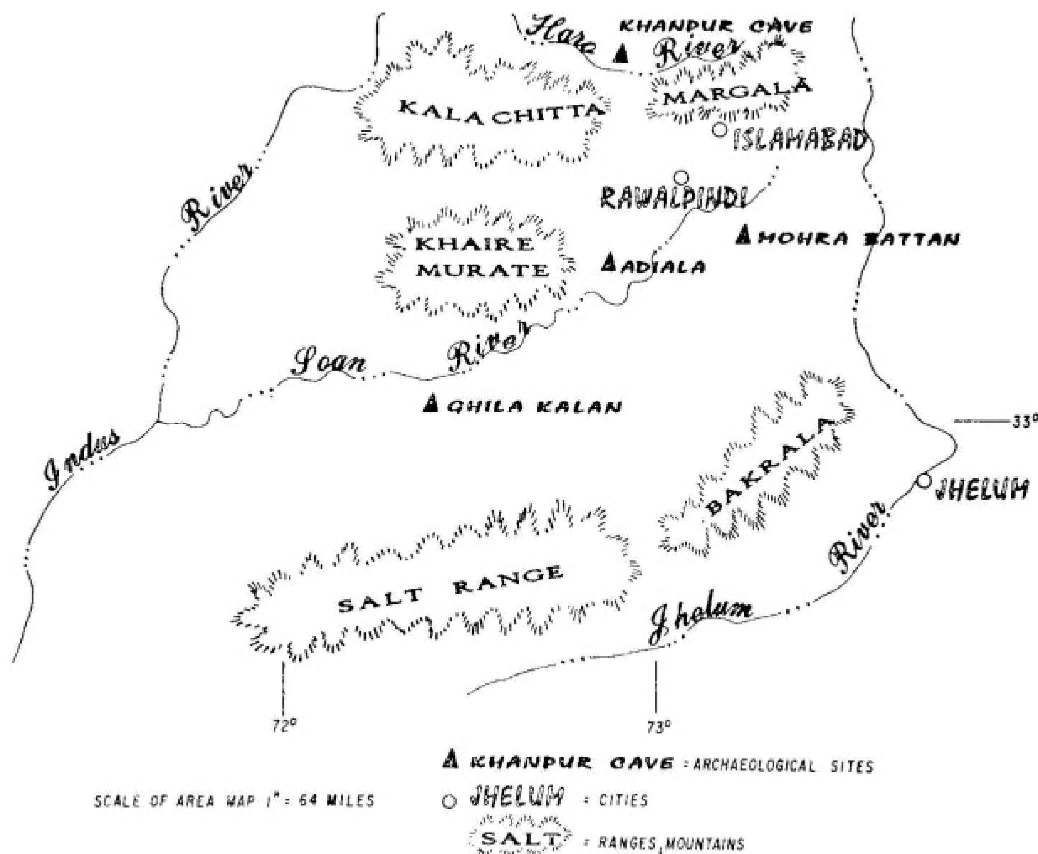


Fig. 1 Map of the Potwar region, West Pakistan.

complex South Asian upper Palaeolithic or Middle Stone Age. The presence of Levallois techniques in Late Soan A also indicates the significance of the region in understanding interactions with the west.

At the present time the status of these latter problems is far from clear. The reasons for this obscurity include both the inadequate definition of complexes associated with the upper Pleistocene in South Asia and the lack of solid dating controls for those already defined. The case has perhaps been overstated by Bordes (1968:200)—who recently noted that "Practically nothing is known about the upper Palaeolithic in India or Malaysia"—for Sankalia (1964), Joshi (1964), Allchin (1963), and their colleagues have certainly added to the knowledge of the period with carefully documented descriptions of the Nevasian and Wainganga B flake industries.

Sankalia sees the Indian Nevasian and the Pakistani Late Soan as contemporary and as distinct industries but sharing an as yet undefined mutual influence (1962:200). He wisely cautions against the fairly common but premature attempts to seek wider affinities "between the Middle Stone Age culture and African (including the Egyptian) or European stone age cultures" on the basis of the limited data now available (1964:374).

Four Potwar archaeological sites that span the time period concerned are described briefly below. Tests were made at each of these sites and, although the resultant assemblages are very small, and the sites need excavation to provide fuller

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Fig. 1 Map of the Potwar region, West Pakistan.

A map of the Soan Valley in the Pothwar region

complex South Asian upper Palaeolithic or Middle Stone Age. The presence of Levallois techniques in Late Soan A also indicates the significance of the region in understanding interactions with the west.

At the present time the status of these latter problems is far from clear. The

peninsular India but also the rest of Pakistan.
that these early stone tools have no close relatives in any other part of Pakistan or India.

Paleolithic Studies in the Pothwar Region: Paleolithic research in the Pothwar region owes its origins to geology as it does to archaeology as most of the stone artifacts were discovered and dated in connection with the geological surveys of the region. Although isolated paleolithic impliments from the Pothwar plateau were reported in the I880s, not until I928 did it become apparent that the Soan valley was rich in paleolithic artifacts (5). In I935 de Terra and Paterson, along with their col



Sunset at the Soan River

leagues Tielhard de Chardin, Drummond, and Sen, collected lithic materials, many of which appeared to be distinct from the Acheulian stone tools that were so common elsewhere. Their association with the middle Pleistocene Boulder Conglomerate of the plateau led them to conclude that these were the earliest indicators of man in South Asia. The Boulder Conglomerate was assigned an antiquity of



A view of Pothwar Plateau

glacial II, and in their report of I939 de Terra and Paterson described I0 localities from which tools of this age had been collected. Paterson and Drummond were able to list 25 sites that yielded assemblages of artifacts in sufficient numbers to allow them to classify the tools according to stratigraphic and cultural *Soan sequence*. This British–American team was also responsible for assigning cultural labels to some of these lithic assemblages as ‘Soan’ or ‘Soanian’ (6) and ‘Soan Flake Tradition’, and broadly placed their origin in the Middle Pleistocene (7,8). Paterson’s observations on the terrace sequences and associated surface assemblages in the Soan valley, led him to believe that several technological phases existed within the Soanian, and were thought to be a result of glacial and interglacial periods.

Subsequent Paleolithic investigations took place not only in Pothwar but also in the nearby areas of Indian Punjab. Investigations were also carried out in the Siwaliks of Nepal and Kashmir. Most of these workers relied heavily on de Terra and Paterson’s work (1939), ultimately resulting in oversimplified and somewhat confusing cultural interpretations. Doubts about de Terra and Paterson’s observations started coming out by mid 1950s and ultimately their stratigraphic picture was substantially altered. The Soan River ‘terraces’ as observed by de Terra and Paterson were proven to be erosional features rather than true river terraces (1). As a result, Soanian technological evolution, as de


Typical landscape of Pothwar

picted by de Terra and Paterson, was no longer considered to be valid, although some assemblages may still be broadly but tentatively distinguishable as Early or Late Soanian types (9).

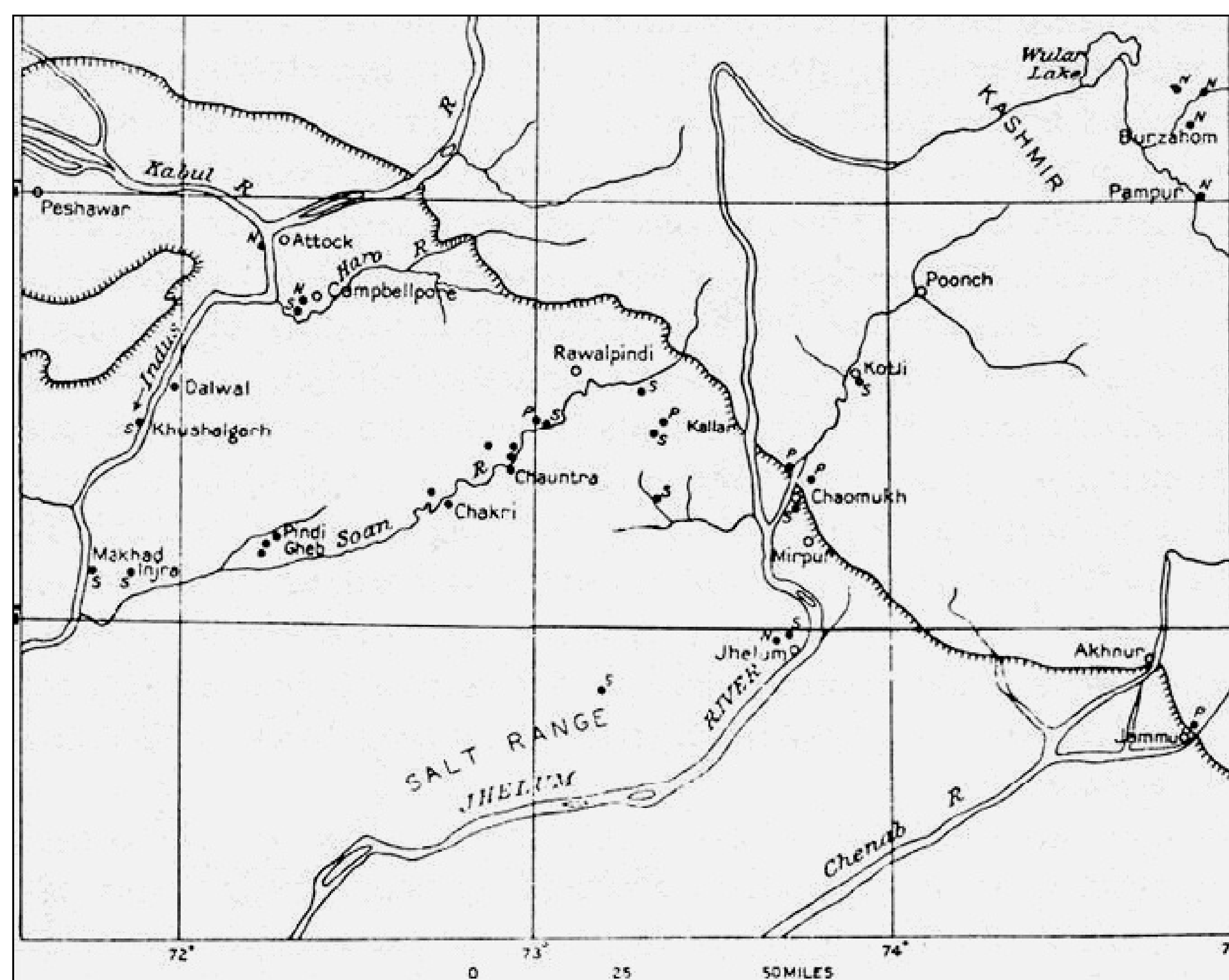
Despite over seven decades of prehistoric research in the Pothwar region, basic functional terms to describe typologically diverse Soanian artifacts remain ambiguous. Attempts at establishing classificatory schemes have been made by various workers for Soanian tool-types (6,12-15). However, none of these schemes are standardized and fail to accommodate new tool-types from the area, possibly a result of biased or non-systematic surface collections rather than comprehensive or systematic random sampling. The sedimentary and tectonic history of the Siwalik region during and following the terminal deposition of Upper Siwalik sediments did not allow considerable deposition of sediments that could have preserved Paleolithic sites (16) and made secure dating possible. The third major factor is the generally low number of Soanian artifacts recovered and their non-datable contexts.

The British Archaeological Mission to Pakistan team succeeded in locating and dating sites ranging from the Lower to the Upper Paleolithic, including two Acheulian sites at Dina and Jalalpur. At Dina, a handaxe was found within and underlying a quartzite conglomerate, and at Jalalpur fourteen artifacts, including two handaxes, were recovered from a gritstone/conglomerate lens. The investigators, Rendell and Dennell, correlated the artifactbearing horizons with deposits that were previously dated to 700 years ago , to 400,000 years (10) The age of these Acheulian occurrences broadly correlates with several early Acheulian sites further south in peninsular India. Similar tools, belonging to the same time line, have also been reported from the tary evidence and fossil fauna, but thus far no correlative hominin remains have been found.

The most important contribution of the British Archaeological Mission was probably the discovery of the artifacts of extreme antiquity, bordering 2 million years of age at Riwat. This was unexpected and, consequently, controversial. There are still some archaeologists who, primarily on theoretical grounds, do not agree with such an antiquity. But, irrespective of this controversy, the discovery is meaningful - primarily on account of their character as a group of artifacts, and of their dated

context.

Despite the importance of the find at Riwat, Pabbi Hill, Dina, and Jalalpur, the majority of paleolithic sites in Pothwar are located in ‘post-Siwalik’ situations. Here, the term ‘post-Siwalik’ refers to sediments which have accumulated after the deposition of the Boulder Conglomerate, the youngest Siwalik Formation. These sediments are dispersed in intermontane valleys, on Siwalik hill slopes, and in association with Middle to Upper Pleistocene



Map showing distribution of Paleolithic sites in northwestern Punjab (after deTerra and Paterson)

Map showing the distribution of Paleolithic sites in northwestern Punjab, the Pothwar Plateau (after de Terra and Paterson)

river terraces of Beas and Ladakh in Kashmir Valley but their veracity has not been proven as yet.

These quartzite pebble tools and flakes date to about two million years ago, according to paleomagnetic analysis, and represent a pre-handaxe industry of a type that appears to have persisted for an extensive period thereafter. The artifacts are associated with extremely rich sedimenriver/stream terrace systems. The Siwalik environment is essentially one of erosion and deposition, coupled with elevation, depression as well as tilting and bending of geological strata as a consequence of tectonic activities. Therefore, Early Stone Age artifact assemblages in the Pothwar region have tended either to be covered by massive deposits of gravel, boulders, and alluvium, or to have remained on or near the surface as a result of selective erosion.

There are scores of Paleolithic sites in the Pothwar region (17): we describe here a few. Only dated sites have been considered but it does not mean that other Paleolithic sites are not important or less significant. The details of the artifacts and their historic interpretations are dealt with in a separate chapter of this book.

Riwat: A crucial Paleolithic site in the Pothwar Plateau and belonging to the very early Stone Age is Riwat, located in the southeast of Rawalpindi. Here, in 1983, a group of quartzite artifacts and flakes were found in a deep gully, beneath 65 meters of silt and conglomerate, which was subsequently dated by paleomagnetic and fission track methods to be about 2 million years old. Of 23 specimen found, three, and possibly five, showed indications of deliberate flaking, and one, a core tool made of a pebble, has had seven flakes removed from three direction. Its position in the matrix in which it was found, with the flaked edges embedded, means that the flaking could have not taken place by natural means at the time of exposure..

Riwat is an area close to the collision zone of the subcontinental and the main Asian plates describeed previously. After the artifacts had been incorporated into the conglomerate the whole deposit had been buried under successive layers of silts and gravels washed out of the rising Himalayan and Karakoram ranges. The layer in which they lay, along with those above and below, had subsequently been folded by further pressure from the Indian plate. The folds or ridges so created were then planed off and dissected by deep gullies and streams. These processes eventually led to the exposure of the artifacts in the conglomerate matrix.

In spite of detailed investigation no hominid skeletal remains were found associated with the artifacts, nor in deposits in the same time bracket, in the same locality or elsewhere in the region. The discovery continues to be a subject of controversy and energetic debate among scientists; a debate that affects the work of prehistorians everywhere, and especially those concerned with the dispersal of early hominins out of Africa (see Section III).

The Riwat assemblage does not show any handaxe or clever and seems in this sense to be pre-Acheulian: the articles found are apparently very simple, and are predominantly flaked pebbles, cortical flakes, disc cores and flakes. The absence of formal tool types has been specifically commented on. The artifact assemblage from Riwat, has been described by Rendell, Dennell, and Halim (1,18).

The finds from Riwat are meaningful primarily on account of their pre-Acheulean character as a group, and of their dated context. Their authenticity is supported not only by independently dated horizon in a broad contextual sense but also by the discovery of increasing number of hominin fossil remains and artifacts of comparable dates in other parts of Eurasia and East Africa. Continuity with later stone industries within the Pothwar region is provided by chopping tools and flake tools found in Siwalik deposits in the Pabbi hills which fall sequentially and chronologically between the Riwat finds and the hand-axe industries of Acheulian type. We shall return to this topic again in subsequent pages.

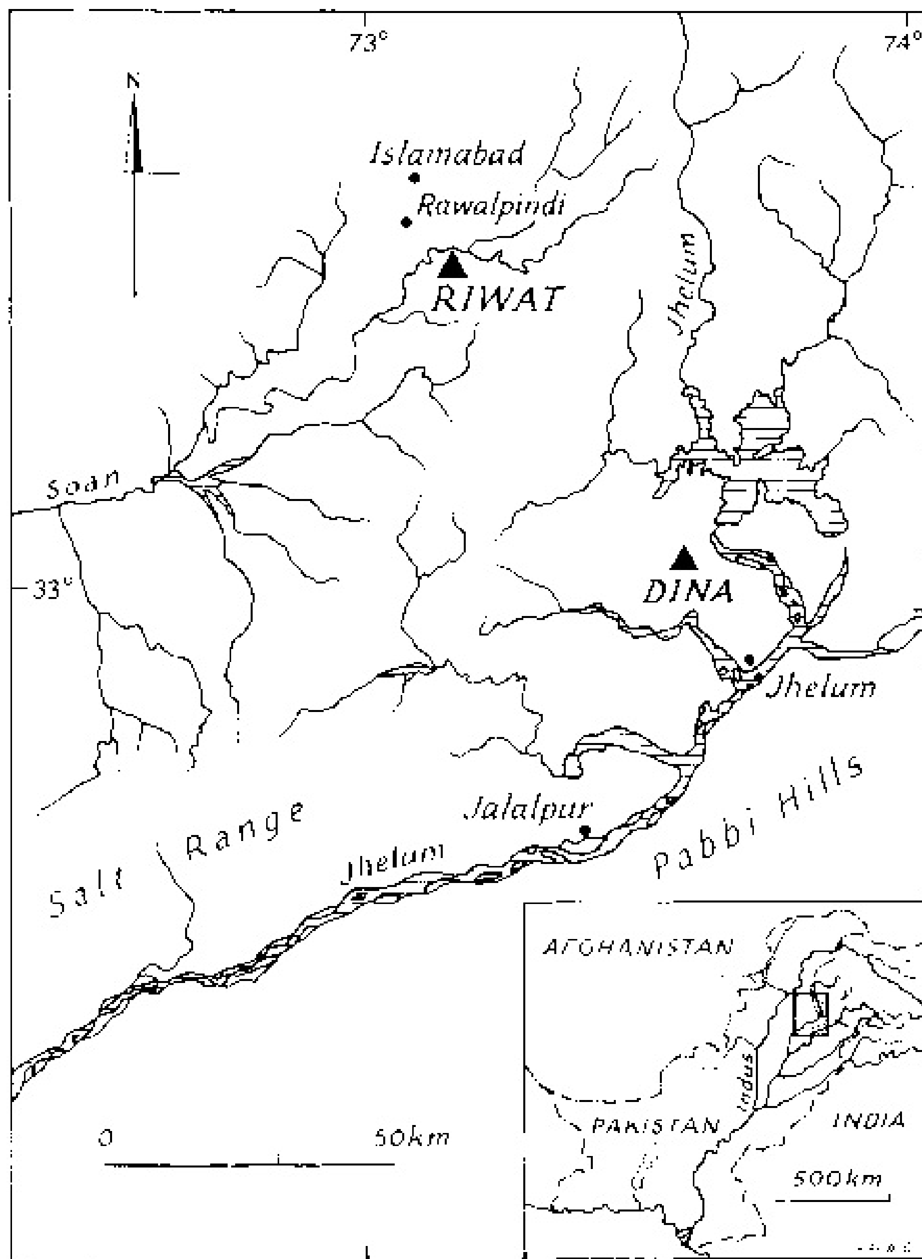


FIGURE 1. Location map of Riwat and its region.

Locatioin of Riwat, Pabbi Hills, Dina, and Jalalpur

Pubbbi Hills: The Pabbi Hills are a low anticline ca. 8 km wide and 40 km long between Islamabad and Lahore that is formed of sands, silts, and clays laid down by an ancestor of the modern River Jhelum whoich lies 3 km to its northwest. The oldest deposits are ca. 3.5 million years old, and the youngest only 0.5 million years old, which thus makes the Pabbi Hills one of the youngest anticlines in the world. Deposition was cyclical, with an average of 30,000-50,000 years and each cycle of sands, silts, and clays was capped by a sandstone. Because of uplift and their greater resistance to erosion, these sandstones are often ridge-forming and useful marker horizons. Most sediments in the interior of the anticline are dated to the Matuyama Chron, whereas the youngest Siwalik sediments on the flanks have an early Brunhes age (0.78 million years ago). Isotopic analyses of soil carbonates show that the predominant vegetation in the Pabbi Hills would have been C4 grassland.

Here, morphologically simple artifacts were found that appear to erode from 0.9-2.5 million years old deposits. The survey, during which these discoveries were made, was undertaken for the study of fossil material and the discovery of the stone artifacts was more or less incidental. The paleomagnetic dating of the region place these artifacts within the same temporal horizon as those at Riwat. Thus, the

finds at the Pubbi Hills are as significant as those at Riwat in their implication on the interpretation of human evolution and dispersal. They are, of course, as controversial as those from Riwat.

Dina and Jalalpur: During early 1980s, Rendell and Dennell, under British Archaeological Mission to Pakistan set out to locate Paleolithic material in secure and datable geological contexts. The value of this approach was first evident in 1983, when they found Paleolithic material in situ at two locations: 1) northwest of the town of Dina and 2) at Jalalpur. At Dina, they extracted a rolled handaxe from within a quartzite conglomerate. At Jalapur, 14 artifacts, including two handaxes, were extracted from gritstone formation. These handaxes have since been dated by other research teams to *ca.* 0.5-0.7 million years ago (19). Compared to the finds at Riwat and Pubbi Hills, the finds at Dina and Jalalpur are not controversial (20) and their dates ca. 0.5-0.7 million years ago is now widely accepted (21).

Other Paleoilithic Site in Pothwar: There are a number of other Paleolithic sites in Pothwar and the Salt Range, which have been investigated by de Terra and Paterson and later on by other researchers. Salim provides a summary in his *The Middle Stone Age Cultures of Northern Pakistan* (17). A few noteworthy examples are: Milestone 163 along the G.T.Road (pre Soan flakes and rolled handaxes), Adial (pebble tools and flakes of Soan tradition), Warwal (core tools of pebble-tools tradition), Chauntra (handaxes and pebble tools), Morgah (handaxes and pebble tools), Makhad, and Pindi Gheb.

THE PESHAWAR BASIN

In 1962, Dani founded the Department of Archaeology at Peshawar University and started to investigate many historic and Buddhist sites in this region and during such a survey in 1963 discovered Sanghao Cave, a Middle Paleolithic site in Mardan District. A number of other rock shelters were later discovered near Sanghao and these are included when one speaks of the Sanghao Caves. The Sanghao Cave is situated about 22 miles northeast of Mardan city and a few miles from the nearest village, Sanghao, after which the cave is named. Dani also called it Parkho-Darra cave, because of its location in a *darra* of that name, and to distinguish it from rock shelters and caves in other gorges around Sanghao. The cave most probably formed due to the undercutting by a water stream, now dried up and lying in front of it. Later weathering of the bedrock, cave wall and rock-falls made it larger.

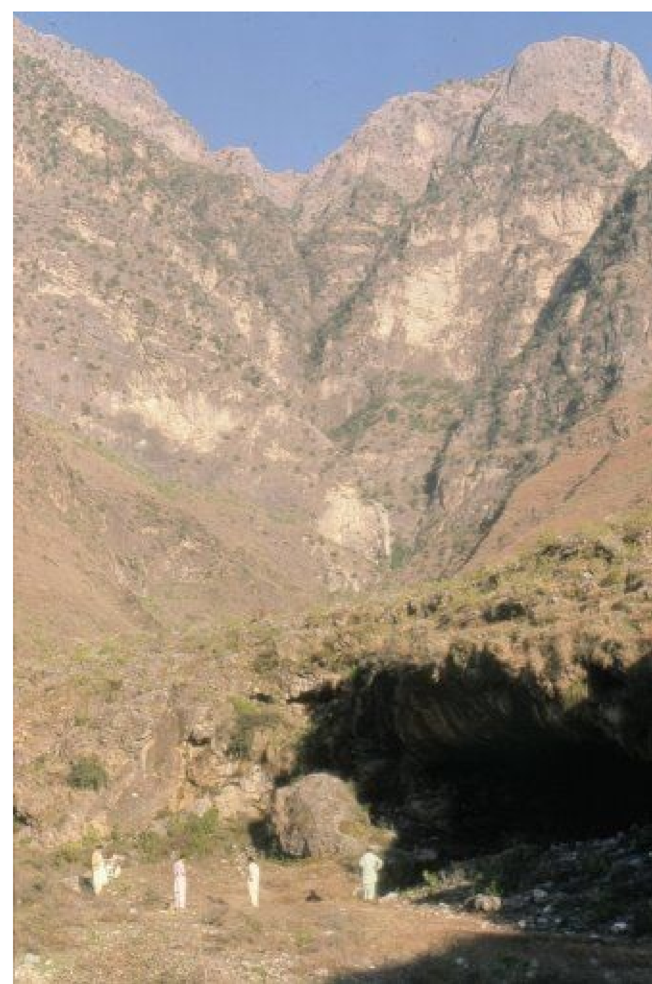
The Sanghao valley is a part of the much larger Peshawar Basin, which is a sediment-filled syncline flanked by the Swat Range in the north, the Khyber Range in the west and the Kohat Range in the south. The Indus River somewhat arbitrarily marks the eastern boundary. Past tectonic activity has resulted in rock formations from the underlying geosyncline projecting through the sediments in parts of the basin. Other than these rocky hills, the basin consists of primarily of piedmont plains, loess plains and flood plains. Drainage is by the Kabul and Swat rivers, along with their minor tributaries, in all but the extreme eastern sector of the area which is drained more directly by the Indus.

Sanghao valley is a rugged area of undulating plains broken by rain torrents. A spur of limestone hills run northwards and eastwards in the form of a semi-circle. The sides of these ridges are heavily dissected and form canyon-like valleys, locally called *darra*. These are further cut up by water action into natural caves or rock-shelters. Dani noticed a number of such caves, many with traces of human habitation. The *darra* which contains the excavated cave is called Parkho-darra and is almost 3 miles

east of the modern Sanghao village. Two other such caves have been reported from the Sanghao valley: Rod, and Bagh-darra. They have not been excavated but the upper surfaces of these cave deposits show Buddhist period remains. Although in a secluded corner of Peshawar Valley, anciently Sanghao lay on the route from Punjab to Afghanistan and constituted an important center of commerce and exchange in the area which later on came to be known as Gandhara. Sanghao is surrounded by many Buddhist settlements, it itself being one, as the name *Sangha* connotes.

The excavation of Parkho Darra cave in the early 1960s showed that in the extreme northwest of Pakistan there was another Middle Paleolithic tradition with pronounced regional character. The cave was found to contain three meters or more of occupation deposit, including a great deal of cultural and organic material such as hearths, bones, and quantities of artifacts and factory debris. Unfortunately, its early date and its importance in these respects were not recognized by the first excavators, and almost all this valuable material was discarded. Four periods of occupation were distinguished, the first three grading into one another, apparently without any break in continuity. The Period I is associated with the Middle Paleolithic. Throughout, the tools are made entirely of quartz, of which there is a prominent outcrop, not much more than 100 meters from the cave. Quartz tends to fracture irregularly on account of its crystalline structure, and it is therefore a difficult material to work with. For the same reason it is difficult to recognize tools made of quartz, as their outline tend to be obscured by its irregular fracture.

There was a major rock fall from the roof of the cave at the end of Period I, which caused the site to be deserted for sometime. Period II yielded animal remains including charred bones and quartz tools which now bore a red stain derived from the reddish color of the soil of the layers of this period. The color of the soil had apparently changed from that of the earlier period. Some disturbance of the rocks has also been reported from the close of Period II. The contents of Period III were generally similar but contained in addition hammer stones of granite and tools made of schist. It may be noted that schist tools occurred in limited quantities in Periods I and II as well. Period IV was dated between *ca.* 2nd century BC and *ca.* 2nd century AD. The

**View of Sanghao Cave in Parkho Darra, Mardan District**

stone tools of all the three prehistoric periods were predominantly made of quartz found in the local outcrops. The industry comprised awls, scrapers.

Dani published the results of his research in 1994 in the *Ancient Pakistan*, a bulletin of the Department of Archaeology, Peshawar University. In spite of some flaws in the report for somewhat hasty work in the excavation (23) it was obvious that the site contributed significantly to our understanding of the Late Pleistocene history of Pakistan, an understanding little advanced from 1939 when De Terra and Paterson published the now classic *Studies on the Ice Ages in India and Associated Human Cultures*. Here for the first time in Pakistan was a stratified habitation site apparently in use for the last twenty to thirty thousand years of the Pleistocene.

The cave was re-excavated in 1975, as part of a larger project being pursued by researchers from Temple University and the University of Peshawar. The 1975 excavations were directed by Farid Khan, Department of Archaeology, University of Peshawar and A.J.Ranere in collaboration with Mohammad Abdul Halim, Department of Archaeology, Government of Pakistan. M.Salim conducted an extensive research on the remains of the Parkhto Darra cave. According to his particle-size analysis of the soils inside the cave, the floor deposits did not seem to be a loessic deposit: 'Most probably the sand and gravel fractions were deposited by the weathering of cave bedrock by wind, rain and frost' (17). Salim's analysis of its faunal material indicated the predominance of sheep, goat, and gazelle, which, according to him, 'would fit into a Central Asian pattern of Middle Paleolithic exploitation of sheep and goats' (17). The climate of the basin can be characterized as hot, subtropical, and continental, varying from semi-arid in the west to sub-humid in the east. The regional vegetation has been heavily modified by agriculture, grazing and the cutting of wood for fires. In the vicinity of Sanghao, for example, the annual rainfall of 650 *mm.* should support a forest cover on the hill slopes,

but heavy human use has resulted in a cover of low brush and grass.

Another group of caves and rock shelters were found in Bannu District around Dre Ghundai. The artifacts discovered at this location also fall in the category of Sanghao artifacts, mainly flakes and including scrapers, notches and burins. There are a few other unconfirmed reports from the area. For instance, a similar caves has been reported from Tanga Nao, Hisar Kot, Khona, Ango Gatkai, Saido Nao and Sarki Kandao near Nawagai, in Bajaur Agency. The uniqueness of the discovery in Bajaur Agency is that they are in the form of clusters depicting the advance stage of Middle Stone Age as compared to the primitive and isolated cave site of Sanghao in Mardan. A few clusters of late paleolithic stone tools including blades, arrowheads, spearheads, core tools, and scrapers are known from Thapalkan and Lar Chamarkand in Mohmand Agency. A similar cave has also been reported near Namal Lake in the Salt range, quite far from the Parkho-darra where Sanghao Cave is located (22). Judging from photographs, the tools are notches, denticulated flakes and scrapers. These flake collections have affinities with the Middle Paleolithic assemblages at Bisitun and Ghar-e-Khar in western Iran (17). An interesting, although unrelated cave site has recently been reported from the Salt Range. There are a few other caves in this general area but they all seem to belong to the Mesolithic period, as transitional stage between the Paleolithic and the Neolithic ca. 15,000 years ago. Only the Sanghao Caves have been excavated so far. THE INDUS PLAINS AND THE THAR

The Upper and Lower Sindh plains is another area which is particularly rich in Paleolithic remains and which has invited considerable attention of archaeologists and prehistorians. The province of Sind is a long and narrow oasis. It consists of the lower Indus Valley, a corridor of highly productive land, in earlier times inundated and today largely irrigated by the water of the Indus running right through an arid land on either side. The strip of cultivated land winds along the foot of the Kirthar Range, dividing its dry stony hills from the sands of the hTar Desert to the south-east. In many respects the valley resembles those of the Nile and the Tigris-Euphrates; like them it has
for a long time formed a focus of
population and wealth in the midst
of surrounding desert region.

Certain positive observations on past climates in the Indus plains were made by de Terra who noted that on the occasion of his visit to Sukkur and Rohri in 1937 with Teilhard de Chardin; they found Harappan factory sites and earlier material on the hills on each side of the Indus near the Sukkur gorge. In a brief discussion of the probable age of the artifacts he writes:

'All that can be said is that the hilltop sites are associated with ancient soils of "terra rossa" type which do not form under present arid conditions. Their origin must date back to a period of greater rainfall which ultimately may have led to inundation of the slope relief because of the overlap of lacustrine silt on the hill slopes along the banks of the old Indus channels. . . and long after lowering of the Indus channel had taken place which brought about dune formation and the Paleolithic sites in this region is her investigation into the climatic changes in the Thar and the outlying Dry Zone during the Pleistocene epoch. Although Allchin and her team were able to find little direct evidence of past climates in the lower Indus region beyond that noted by de Terra, Stone Age factory sites on the limestone hills of upper and lower Sind leave no doubt that the valley of the lower Indus was inhabited during the middle Pleistocene.

The study of the prehistory of eastern Sindh and western Rajasthan is essentially the study of the Thar

and researchers like Bridget Allchins have treated it like such. The Thar Desert, also known as the Great Indian Desert, encompasses 77,000

desert .....' (34).

A great deal of quarrying
has taken place in the locality of
Sukkur and Rohri since de Terra's
visit and much evidence of this kind
must have been lost. De Terra’s
observations are of particular inter
est on this account, and because
they relate to observations made
since by Allchin in Gujarat and Ra

Prehistory and past climates of surrounding regions

In the Las Bela district of southern Baluchistan and adjoining districts of Sind (Fig. 2), a sequence of Lower, Middle and Upper Palaeolithic, Mesolithic and

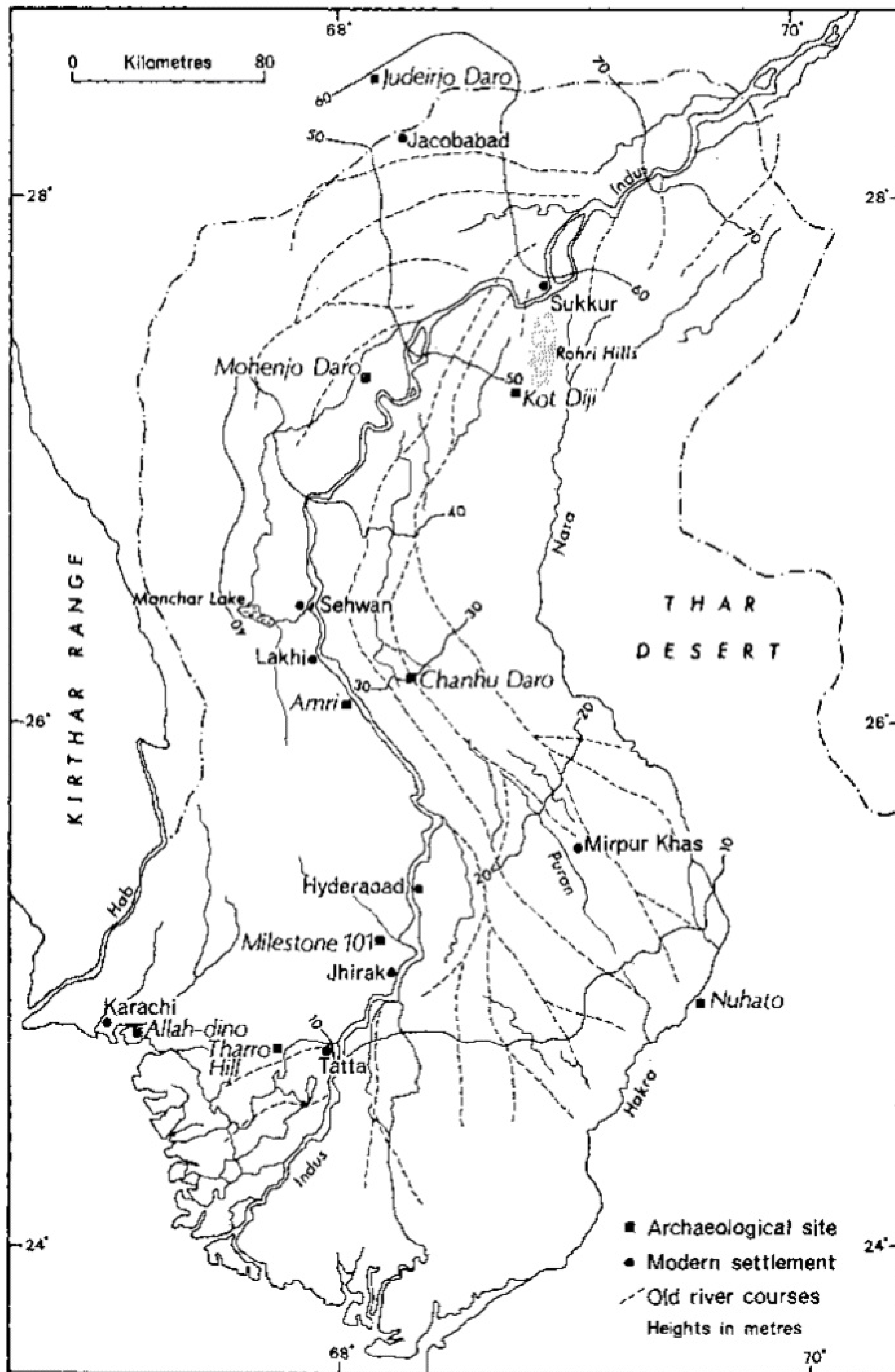


Fig. 2. Archaeological sites in Sind

The map of the Lower Indus Valley and the adjoining Thar Desert

jasthan (27) and later by Biaggi in his several reports during a decade long work in this region. Bridget Allchin's survey of this region in 1976 was a hasty survey but it provided the first Paleolithic record from this focal area of Th.e Stone Age of Pakistan (25,26). More important than describing square miles of rolling sand dunes in eastern parts of Pakistan and the northwestern section of the Indian state of Rajasthan. Small portions of the desert also extend into the Indian states of Haryana, Punjab, and Gujarat, but these states do not exercise extensive control over the region. The Thar Desert's name derives from the word *thall*, the general term for the region's sand ridges. It is defined by a series of natural borders, including the Aravalli Mountain Range to the southeast and the Punjab plain in the north and northeast. To the west, lies the Indus plain, and to the south, the Rann of Kutch.

Rainfall throughout Sind is unreliable, and in some years there may be none or virtually none; the average is maintained by occasional exceptionally heavy rains. The average at Sukkur in Upper Sind is 90 mm and that at Hyderabad in Lower Sind is 174 mm. After water and a productive soil, one of the most important natural resources for agriculturalists, pastoralists and hunters prior to the Iron Age was a supply of suitable stone for tool-making. The geographic isolation of the Thar Desert by mountain ranges and plains contributes significantly to the weather patterns that shape its distinctive, hot, dry environment. The environment around the Thar effectively absorbs all the rain that is carried in the monsoon clouds before the clouds can reach the desert. The resulting monsoon winds in the desert are hot and dry, and the desert does not share in the wet season what is experienced in the surrounding terrains.

Seen in a wider context, the Thar is the south-eastern extremity of a much larger desert region extending through Sindh, Baluchistan, Afghan/Seistan and the Iranian Plateau almost to the Zagros Mountains in the west, and northward to the Hindu Kush and beyond. This whole desert region is in turn a part of the great Saharan-Arabian Desert belt. While being an extension of the larger desert region, the Thar is in a sense also an island, surrounded on all sides by the more fertile lands of Sindh, the Punjab, Gujarat and Rajasthan, all regions which have some of their roots very firmly embedded in the early cultures of the Indus Valley.

Bridget Allchin has shown that there is clear evidence of two or more arid phases each represented by fossil sand dunes on the east and southeast in the Dry Zone, on the margin of the Thar desert, and of a phase of considerably greater humidity than the present, represented by a well developed fossil soil, preceding the last arid phase (26). Middle Paleolithic industries are widely associated with the fossil soil of the humid phase and so to a more limited extent are Upper Paleolithic industries. In the interior of the Thar desert stratigraphic evidence of past climates is lacking, but dead drainage systems, now blocked by sand dunes in many places, bear witness to the more humid climates of the past. Middle Stone Age sites and artifacts are widely associated with them in extremely arid regions such as Jaisalmer and Bikaner districts where human life cannot be supported today without deep wells and other hydrotechnology unavailable to the Stone Age man.

The interaction of human communities and their surroundings is always crucial on the margins of a desert. A series of drought years, or a sudden flood can devastate vast areas, killing people and animals, and wiping out years of effort. On the other hand, man, while seeming for a time to win the battle against nature, can upset the ecological balance even more drastically than these natural calamities, and by continuous over-exploitation for a period of years he can destroy the potential of

the desert margins for centuries to come. Both aspects of this situation are as evident in the case of this region as on the margins of the Sahara, or the deserts of Western and Central Asia.

It is obviously impossible to assess the present-day political, economic and social life of such marginal regions without some understanding of the geographical setting which imposes severe controls and limitations on all human activities. The same applies to history. The Indian desert has played an important role in relations between the agriculturally rich regions which surround it, the Indus Valley, the Ganges Plains, the Malwa Plateau and the plains of Gujarat. All land communications, all movements of people and animals had to go round it, or cross it at their peril. It also had its own influence in separating the cultural spheres to its west (Pakistan) from that to its east (penninsular India) which eventually got translated in political boundaries since the neolithic times or even earlier.

Notwithstanding the expanding and contracting boundaries of the Thar and their implications on the human settlements on the margin of the desert, our primary interest lies more in the margins of the Great Desert rather than the Desert itself because it is here that most abundant evidence of changes in the climate and landscape of the past can be found. We are particularly interested in the area which constitutes a broad belt of low and uncertain rainfall along the eastern and south-eastern borders of Pakistan or the western margins of the Desert itself. The area extending to the west of Indus, all the way to the Kirthar Range and covering the plains of Lasbela is also included in this interest. This belt of varying width, which has been called by Allchin as the Dry Zone, is rich in prehistoric remains and a repository of artifacts in the form of Paleolithic sites of all periods. The Paleolithic character of this zone, as a separate region, is both distinct from and complementary to that of the Thar, so that no account of the Thar would be complete without some account of the Indus Valley. This applies particularly to early prehistoric times because of the remarkable Stone-Age sites in the valley itself (28).

A highly significant feature of the plains of Sindh, more particularly, that of the Dry Zone of the Lower Indus Valley, is the rapid accumulation of sand, clay and silt during the past 5000 years. Lambrick (29) on the basis of observations on the excavations at Mohenjo-Daro suggests a rate of 1.71 m per 1000 years. This rapid accumulation must be part of a process that has been going on throughout the Holocene. It must have changed the landscape of the valley considerably by covering outcrops of rock in the valley floor and stony fan material at the foot of the hills on the north-west side, both potential sources of raw material for tool making and places where one would expect to find Stone-Age sites of all periods. It is highly probable therefore that many sites of archaeological interest have been submerged under the alluvium.

The outward extensions of arid conditions and of actively moving sand along a broad front, alternating with the amelioration of climate, the formation of soils and establishment of mature natural drainage patterns are the basis of the mode of existence of early humans living on these margins of the Desert. Such far reaching changes must have affected the very existence of Stone-Age communities. Therefore establishing the relationship between major climatic phases, and major cultural periods of the Stone Age, even in general terms, is the first step to understanding collections of artifacts as part of a cultural continuum maintaining an ecological balance throughout the region as a whole in the face of profound environmental change. Bridget Allchins and her associates have addressed these issue in their studies of the Thar and the Dry Zone. We shall review these studies elsewhere.

The environment that the Dry Zone of Sindh offered to the scavengers, hunters, and food gatherers of the Stone Age must have been remarkably rich in contrast to that of the desert interior of extreme aridity. As at present, the rainfall must have been very low and often nonexistent, but the Indus brought a continuous supply of sweet water into the desert. Inundated areas of the plain must have produced a luxuriant growth of grass and other plants during the autumn and winter and must have sustained a rich variety of wild life. Such an environment must have had a rich and varied vegetation and been supremely attractive to food gatherers.

The Indus is also a frontier dividing the Indian sub-continent from Western Asia, as, in its upper reaches above its confluence with its major tributaries, it forms the natural frontier between the Indian subcontinent and Central Asia. Its character as a boundary predominates because it divides two deserts of very different character; one on the northwest consisting of young folded mountains, stony and barren with rare fertile valleys, and the other on the south-east of ancient rocks, level plains and low hills, much of it mantled in sand. The delta and the lower part of the valley, known as lower Sindh is slightly cooled by marine influences and receives a very slightly higher rainfall than the interior.

The Paleolithic Sites in the Lower Indus Valley and the Thar: Paleolithic sites of the Middle Stone Age abound in Sindh. There are signs of human activity, especially in the Lower Sindh, in the Early Stone Age. A large number of artifacts found both at Rohri sites and those in the Ongar (Milestone 101) area have been placed by archaeologists in the timeframe that is generally designated as the Upper Paleolithic or the Late Stone Age. Mesolithic sites have been recorded in Las Bela on the north-east, where silt accumulation is more localized and in the Thar to the south-west on both sides of the valley. Throughout this area, sites tend to be located on spurs, bluffs and terraces overlooking major rivers and smaller water stream. These sites are, however, not many. It seems likely that any Mesolithic sites there may have been covered by alluvium. Many sites of earlier periods must have suffered the same fate, and so must many preHarappan and Harappan settlements. Indeed, considering the unstable nature of the river and its powers of destruction today, together with the rapid rate of aggradation, it is remarkable that any Chalcolithic settlements have survived in the plain. Some of those, such as Amri and Kot Diji, that appear to be situated in the plain, were in fact founded on hard ground at its edge and have since become surrounded with silt, like a slowly rising tide. Mohenjo-Daro, apparently founded on the plain, has probably survived on account of its great size.

Although few Stone Age settlements have been recorded from the alluvial plains of Sindh themselves, as might be expected, the so-called factory sites, however, have been found at Rohri Hills in Upper Sindh and around Hyderabad in Lower Sindh. They are all located at the top of the chert outcrops from the alluvium. These chert nodules have been used to make stone artifacts. These sites were first noted by John Evans (1866) and briefly described by Blanford (1880) and Marshall (1931) prior to de Terra and Paterson in 1939. Several later researchers visited these sites and continued vaguely referring to the artifacts found there as ‘Harappan‘ or ‘pre-Harappan’.

Rohri Hills: The Iargest group of Paleolithic sites in the subcontinent is in the Rohri Hills in up



The Rohri Hills as they appear along the western fringe of the plateau, facing the fertile Indus Valley, where most of the Harappan flint quarries and workshops have been

discovered

per Sindh. Situated within an intensely arid region, they cover an area measuring some 40 km from north to south and 16 km from east to west. At present the Indus flows in an east-west direction through the Bukkur gorge near their northern end, and then turns southward approximately parallel to the long axis of the plateau. The old course of the Nara, thought to have been at times an alternative course of the Indus, and at other times perhaps to have carried the waters of the Sutlej prior to its capture by the Indus, also cuts through the northerly part of the plateau and then follows its eastern edge. Apart from the immediate vicinity of the river and one or two hollows in the hills with a few green plants and bushes, the landscape of the Rohri Hills is very much a desert landscape. The hills are flat topped and of a more or less uniform height, about 40 to 50 m above the plain, with steeply sloping sides and troughs of varying widths between them. Many of the hills are capped by a layer of chert nodules. Bridget Allchin (28) visited these hills and described them as a 'dissected limestone plateau than a hill range'. Today the limestone from this area provides a valuable source of stone for road and building material as well as an essential base for the manufacture of Portland cement.

The hills separate two environmentally very different regions: the fertile, cultivated plain of the Indus to the west, and the poorly vegetated fossil sand dunes of Thar Desert to the east. A break in the hills can be observed a few km east of Rohri, most probably due to the course of an old river channel. In effect the city of Aror (or Alor) itself lies close to another old river channel, which is said to have passed by the ancient capital of Sindh. This city is supposed to have been destroyed by an earthquake around the middle of the tenth century AD. A few more isolated small limestone hills, detached from the major group of terraces, can be observed some 3 km north of the Indus river at Sukkur, where de Terra and Paterson were the first to discover scatters of man-made flint assemblages on their tops.

Although the Rohri Hills have been known since the end of the 1880s as a raw material source for the prehistoric human populations that inhabited the Indus Valley, a project of systematic surveys and excavations in the region, called "Joint Rohri Hills Project", was promoted only in the 1990s by an Italian university and Shah Abdul Latif University, Khairpur (Sindh, Pakistan). Nevertheless the importance of the Rohri Hills for the exploitation of the lithic raw material supply for the artisan workshops of Mohenjo-daro had already been suggested by Mackay, following the observations he made during the excavations carried out at the Indus Valley main site.

The first to report the presence of flint artifacts of the Paleolithic period from this region was Blandford, who, describing of Rohri Hills, wrote that “the surface of the limestone consists in general of a series of low slopes, corresponding in direction to the dip of the rock. The flints weather out and cover the surface throughout a large area; cores and flakes split from them being scattered about in abundance in some places”. The same author mentions the recovery of “some flint cores, from which flakes have been chipped, obtained from Lieutenant Twemlow, R.E., in the bed of the Indus. The cores were remarkable for their regularity”. These cores were first illustrated by J. Evans who was “superintendering excavations connected with a canal, near Shikarpoor, in Upper Scinde”. Furthermore Blandford reports that “large quantities of flint cores have been found near Sukkur and Rohri, and there is a good collection in the Geological Museum Calcutta”.

Apart from the re-discoveries made by De Terra and Paterson, it was Bridget Allchin, who visited the northernmost edges of the hills, near Rohri in December 1975. Here she observed “extensive Harappan working floors on the top of several of them”, which were illustrated by the same author in another paper, where she describes each of them as “an area large enough for a man to sit crosslegged”, which “had been completely cleared of stones”. In recent years Paulo Biagi has done quite extensive work in this area. He also posted an excellent pictorial summary on the internet at www.Harappa.com.

Allchin reports that almost all the chert on the hill tops visited by her showed some evidence of human work, and when walking on the hills one could not avoid treading on artifacts and factory debris. It soon became clear that the Harappans had cleared away an upper layer of darkly patinated flint in places in order to reach the more lightly patinated nodules below, probably because they had been protected from weathering and therefore had fewer flaws and were more suitable for making the elegantly regular Hrappan blade cores and blades. In doing so they had piled up the unwanted nodules of chert or simply thrown them down the hillside.

Besides the stone artifacts from the Harappan period, Allchin and her team found a lot of rejected material which they assigned to the factory debris and tools of earlier periods, particularly of the Middle Paleolithic.

“On many of the hills there were working floors or factory areas, the majority of which appeared to belong to the Middle Paleolithic. Middle Paleolithic craftsmen had used the nodules available on the surface, and their debris and discarded artifacts were fairly deeply patinated and also heavily sand blasted, indicating that large quantities of blown sand must have passed over the hill tops since the artifacts were made. Middle Paleolithic factory areas were found in the interior of the hills, far from the plain where the Indus, the Nara or any equivalent major river could have flowed. Today this is an extremely arid region, and there are no local water supplies except those dependent upon modern technology. Both the distribution and quantity of Middle Paleolithic material indicate that the climate in Middle-Paleolithic times must have been considerably less arid than that of today” (25).

“If the climate had been like the present and major rivers with sources outside the desert had been the only sources of potable water, Stone-Age sites would have been concentrated near the courses of those rivers, whereas their distribution suggests that adequate water supplies were available locally within the Rohri Hills. The very large quantity of Middle Palaeolithic material in the Rohri Hills can only indicate that they supplied a great many people with tools over a long period of time. Indeed the relationship of these factory sites to other Middle Palaeolithic sites we have described in the Thar

Region is like that of a city to a number of small hamlets. In Middle Palaeolithic times the Rohri Hills must have supplied stone artifacts to the inhabitants of the river valley and probably also to people in surrounding regions. This must have necessitated a widespread network of social and economic relationships, the nature of which we can only guess at present. (25)"

"The artifacts were aIl fairly heavily sand blasted so that the sharp edges had been blunted, and generally patinated a dark brown, but not so dark or heavily patinated as the surfaces of the original flint nodules. In this respect they are in marked contrast to the Harappan factory debris. Middle Palaeolithic cores and flakes of many different kinds were heaped up with other debris, or lay on the sides and at the foot of hills on which the Harappans had worked. When pieces of chert worked into artifacts in Middle Paleolithic times were broken, the actual body of the chert was found to be a rather different color all the way through from that used by the Harappans. The chert worked by Middle Paleolithic craftsmen was dark grey with the mottled black and rust colored patina mentioned above; in contrast, that used by the Harappans was a light buff with a cream colored patina" (25).

"In addition to Harappan and Middle Paleolithic working floors, we found one which appeared to have been used entirely to make parallel sided blades of Upper Paleolithic from the same dark patinated chert as the Middle Palaeolithic artifacts. These were distinct from Harappan blades, being altogether thicker and less regular in outline and having much larger bulbs of percussion, indicating a different technique of striking off the core, probably by a direct blow with a stone hammer" (25) .

"The most clearly differentiated Paleolithic site we saw in the Rohri Hills was at their southern end near the village of Chancha Baluch, and only four kilometers from the pre-Harappan and Harappan settlement of Kot Diji. A small limestone ridge with a layer of chert on the top is located to the south-east of the village, and irrigated fields come to the foot of the ridge on the west and north-west. On the south-east, at a slightly higher level, there is a certain amount of actively moving sand, forming small dunes on the relatively hard compacted surface of what appears to be an old silt terrace. Spread out over an area about 100 meters by *50* meters, on a largely sand-free area between dunes, are Middle and Upper Paleolithic artifacts and factory debris" (25).

Bridget Allchin also discovered many Paleolithic workshops close to the Bronze Age mound of Kot Diji, more precisely at Chancha Baluch and Nawab Panjabi. While nobody knows exactly where the first site is located, the real name of the second one is Unnar (or Unar). This site is of extreme importance because of its stratigraphic sequence and the discovery of heavily patinated Acheulian bifacial handaxes. Unfortunately this site was totally devastated by quarrying in the 1980s and all the lithic assemblages on its top removed and dispersed.

The discoveries made in the 1990s by the Italian team, headed by Biagi, especially improved our knowledge of the Paleolithic in the region thanks to the excavation of the Late Acheulian site Ziarat Pir Shaban (ZPS1), north of Shadee Shaheed, the Late Palaeolithic sites Ziarat Pir Shaban and (ZPS2, ZPS4) and the Middle Palaeolithic site 797. It was possible to remark the great abundance of Upper Paleolithic sites, which are mainly distributed all over the western fringes of the central terraces of the hills. During the same years Negrino and Kazi, thanks to the data provided by the excavation of the above-mentioned sites and the typological analysis of all the Paleolithic assemblages discovered in the hills, were able to establish a first chrono-typological sequence of the Paleolithic of Upper Sindh, although many sites continued to vanish due to the impending industrial activities. It is important to point out that a huge Acheulian site, very rich in bifacial tools, discovered in the same

year came very close to destruction.

Milestone 101 (Ongar): Similar to those at Rohri Hills, factory sites have also been found in Lower Sind on a flat-topped limestone hill overlooking the Indus plains from the north-west, opposite to Hyderabad and known as Milestone 101 or Ongar. This is also an area of very low rainfall, but which is slightly higher and more regular than that of Upper Sindh or the central Thar desert.

This site was first described by Bridget Allchin who visited it in 1975, although it had been visited and put on record before by an officer of the Pakistan Government Archaeological Department without studying it. As Allchin described the site, the hill is topped by a layer of flint nodules, extending over an area of two hectares or more, which had been used during virtually every technological phase of the Paleolithic. They found the overlapping working areas of different periods "which appeared to have been virtually untouched since the Stone Age craftsmen departed". The most striking feature was the quantity of Lower Paleolithic material, especially handaxes, in various stages of manufacture from roughouts to virtually finished pieces. A high proportion of the material appeared to belong to the Lower Paleolithic, including hand-axes and cleavers, and seemed to be predominantly Acheulean. "There are discernible working areas of certain periods, but they tend to overlap with others making any kind of analysis difficult".

Allchin's results bring out certain important ways in which the site differs from those in the Rohri Hills. In the total artifact collection from Milestone 101 the proportion of characteristic Lower Paleolithic artifacts is relatively high; cleavers, chopping tools, hand axes and core tools of ovate and carinate form total 64, or about 19 per cent of the collection. Blade cores, blades, end scrapers made on blades and the by-products of blade production generally account for a high percentage; flakes from prepared or previously struck cores which vary considerably in size so that they might be part of Lower, Middle or Upper Paleolithic industries probably some are associated with each, form over 40 per cent of the total collection; about *20* per cent is made up of artifacts associated with the Middle Paleolithic tradition such as certain types of flake cores and points or of artifacts such as scrapers of various types which could be part of either a Middle or an Upper Paleolithic industry. The majority of the artifacts are heavily weathered and sand-blasted.

On the basis of their small size and fresh appearance, a small proportion of blades and blade cores from Milestone 101 might belong to a Mesolithic or pre-Harappan industry rather than to the Upper Paleolithic. But there is no evidence of Harappan activity at Milestone 101 such as one saw in the northern Rohri Hills, nor of extensive blade factories of the kind noted at Nawab Panjabi in southern Rohri. One can only conclude that Harappan sites in southern Sind, such as Chanhu Daro, Nausharo and Allahdino, for example, had other sources of chert or brought it from the north. The same must apply to the extensive pre-Harappan site on Tharro Hill about 10 km west of Thatta. The stone industry includes a whole range of forms not found in Harappan assemblages, which give it a distinctly Mesolithic character, and the size and proportions of the blades and blade cores correspond fairly closely to those from Nawab Panjabi. It is made of very fine quality brown chert, and with it is associated a pre-Harappan ceramic industry and numerous remains of fish.

In all probability, this is a settlement of the pre-Harappan period, perhaps in its later phases continuing alongside the Harappan, probably inhabited by people who drew a large part of their livelihood from fishing. The main channel of the Indus flows to the east of Thatta today, but, being in the delta, changes in the distributaries of the Indus and the coastline have been frequent in recent

times. This supports Lambrick's argument (29) in favor of a considerable degree of general stability in southern Sindh since Harappan times, in spite of local changes of the kind just mentioned. The apparently continuous use of the factory site at Milestone IOI throughout the Paleolithic and its undisturbed character further reinforce this argument for a certain degree of general stability in the region even during the latter part of the Pleistocene.

In regions of extreme aridity today, such as the Thar and upper Sindh, there appears to be little evidence of a Lower Paleolithic presence but a considerable amount of Middle Paleolithic material. In regions near the coast with a marginally higher rainfall today, such as Kathiawar and Las Bela district, Baluchistan, both are represented. It is interesting to note that the Lower Paleolithic material is more prominent at Mileston 101 while the Middle Paleolithic material more common at Rohri sites. This conforms to the general distribution of artifacts in the Indus plains.

The Las Bela Plains: A sequence of lower, middle, and upper paleolithic industries has been reported to have been worked out in the Las Bela district of south Baluchistan and there are unconfirmed reports from other areas as well. What makes these reports *prima facie* acceptable is that there is detailed publication on an apparently pebble-based middle Paleolithic industry dominated by scrapers of different types made on quartzite, chert, and rarely jasper from the Ladiz and Mashkid valleys in Iranian Baluchistan just across the IndoIranian border (30). This industry - which has been called the Ladizian industry - demonstrates that the Baluchistan sector of the greater Indus Valley is most likely to yield paleolithic materials in future. Apart from the artifacts belonging to the Paleolithic,


A general view of the Leasable plain, viewed from the side of Hub

microliths of the Mesolithic type have been found at several places along the coastal line around Karachi as well as to the west. There have been, however, no systematic study so far.

DISAPPEARING ARCHAEOLOGICAL LANDSCAPES

It is to be lamented that a host of the Paleolithic sites, some of which described above, have been shamelessly destroyed in the past fifty years to make room for new ‘Defense Housing Societies” or for exploiting the mineral riches of the land. For example, potentially rich Mesolithic sites have been filled in to make room for the Karachi Golf Course, proven Late Paleolithic artifacts have been

scraped and dumped into waste without even having a casual look at the site of the Karachi University Campus. Similar fate was meted out to the Paleolithic sites in Liyari near Karachi and potentially fruitful areas on the banks of River Malir (near Karachi) was mercilessly brought under cultivation without any consideration for the safegaurd of the Paleolithic heritage of this region. A similar treatment has been given to the Paleolithic sites in Pothwar; several sites have vanished for the reconstruction of the G.T. Road, several to make room for the housing societies in and around Islamabad. It is appalling that not the least attention has been given to conduct even a rudimentary survey before the site was destroyed for ever. It is hard to imagine a nation so adverse to its past.

The fate of the sites at Rohri Hills and the Milestone 101 was no different. Bridget Allchin, at the occasion of her visit at Rohri Hills in 1975, states that everywhere she and her associates went in the Rohri Hills, particularly on the more accessible hills, limestone was being quarried for road metal and other purposes. The first step in this process was to gather all chert, including artifacts, etc., into small heaps, a process which effectively destroyed the evidence of working floors but "was distinct from the Harappan method of removing and banking up the upper layer of chert to expose the lower." In the vicinity of the medieval city of Aror they noticed shallow rock shelters beneath the overhanging cliffs on some of the limestone hills. Some appeared to have artifacts and occupation debris mixed with limestone roof fall. Since all of these cliffs have now vanished thanks to the mining of limestone for cement factories, there is no more any chance to investigate these interesting and potentially revealing stratigraphic information.

Paulo Biagi, the head of the "Joint Rohri Hills Project", which ended important discoveries and many data, writes (31) that the team was unable to stop the progressive, systematic destruction of the archaeological sites of the hills because of the absence of any interest by the local authorities, federal government, even by the Institute of Archaeology of Shah Abdul Latif University, Khairpur, the institution who was supposed to be working in the interest of archaeology. Repetitive appeals for the safeguard of the region personally made by Paulo Biagi to the Governor of Sindh in the company of the General Consul of Italy in Karachi (2000), the Commissioners of Sukkur and Kot Diji (2001), the ViceChancellor of the Shah Abdul Latif University, Khairpur and the Directors of the same Institute (1996- 2001) have systematically resulted in no action by all the above-mentioned authorities. Furthermore the "Seminar and Exhibition on the Archaeological Discoveries of the Rohri Hills, Khairpur, Sindh" held at the Department of General History of Karachi University in February 2000, promoted and financed by the General Consulate of Italy and in particular strongly supported by the then Consul General Dr. Mario Cristofoli, did not produce any concrete result either. The same can be said for an appeal to UNESCO-WHC director in 2001. in 2002 after so many the publication of so

V.4. References

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Ancient Pakistan - An Archaeological History

SECTION VI A PALEOLITHIC JOURNEY



VI.1. Paleolithic Sequence VI.2. The Earliest Stone Artifacts in Pakistan VI.3. The Early Stone Age VI.4. The Middle Stone Age Industries VI.5. The Later Stone Age VI.6. References

VI.0. A Paleolithic Journey



It must be apparent by now that The Stone Age takes its name from the stone artifacts, mostly tools and implements, which early humans fashioned and used. This period of human existence, technically named the Paleolithic period of human history was extraordinarily long. It extended from *ca.* 2.5 million years ago with the introduction of stone tools by our hominin ancestors to the introduction of agriculture around 10,000 B.C. This journey of man, appropriately named *A Paleolithic Journey* by Bridget Allchin, was not only long but also a truly adventurous and risky one. The story of this epic journey has been told and re-told by many archaeologists, anthropologists, geneticists, and prehistorians from their own individual perspectives and interpreted from their own points of view.

In this section, our aim would be to retrace this path and see if we can recognize in the caravan the early inhabitants of Pothwar, the Peshawar Valley, the Rohri Hills, the coastal Sindh, Mulri Hill, the Bugti country, and the plains of Las Bela. As we bring the Paleolithic picture of the Greater Indus Valley in focus, we want to see as to how this picture fits in the broader canvas of the Old World. In short, identifying Pakistan’s technological place in the paleolithic cultures of early humanity is our goal. As the reader proceeds through this review of archaeological discoveries, attention is directed to the broad spectrum of variations in paleo-ecological settings that were exploited by paleolithic communities; the developments in the stone tools technology; the cultural aspects of the hunting-foraging ways of life across time and space; and the evidence for gradual, rather than abrupt, cultural transitions documented for most of the archaeological sites in Pakistan.

The skeletal evidence of this human journey is sorely missing in Pakistan but we trace the early human tracks by studying the stone tools which the early humans and their ancestors left behind around their campsites, the discarded stone tools lying in river-beds, the production waste and the ‘work-in-process’ specimens at tool-making ‘factories’, and bits and pieces of stone artifacts found embedded in geological strata of the yore, discounting an occasional bone of hunted or scavenged animals. It is not our purpose here to dwell on this evidence in great details since this subject as a whole is probably of more interest to archaeologists and paleoanthropologists than to those who are more interested in the prehistory of this land. Such findings have been amply described in academic journals and discussed at length in several monographs and books publish during the last half of the last century. A partial list is included in the Bibliography at the end of this book. The present Section serves as a bird eye view of the technological changes that may have happened in Pakistan in response

of its inhabitants to their changing environment. An important consideration of this exercise is to see how the activities of man in this part of the world relate to those of the rest of humanity.

We begin with the discussion as to how the Stone Age materials have been classified by prehistorians in Africa, west Asia, and Europe; how this classification has been applied to the stone artifacts found in the subcontinent since 1863, when Robert Bruce Foote discovered Paleolithic tools in Tamil Nadu, India; how the stone tools at different regions of the subcontinent resemble (or do not resemble) those found in Europe and Africa; how the stone tools found in Pakistan generally resemble or differ with those found in peninsular India; and how the early stone tools from the North of Pakistan are differentiated from those of the rest of the country. It is followed by a description of Stone Age technologies on a historical sequence in terms of the Early, Middle, and Late Stone Age. Since this periodization is only a rough measure, the reader will find a considerable overlap in the description of the stone tools and their manufacturing technologies. Parts of this section may also overlap with the material covered in the foregoing section.

VI.1. Paleolithic Sequence



Stone Age covers the greatest portion of human existence on earth, extending from 2.5 million years ago, with the introduction of stone tools by hominins such as *Homo habilis*, to the

introduction of agriculture and the end of the Pleistocene around 10,000 BC (1). Such a long period of prehistory cannot be studied without some type of systemization and periodization. Thus we begin with a review of the classification and periodization of this immense span of time, which we call the Stone Age or more accurately the Paleolithic Period of human history. As we proceed, we realize how the systems of organizing the complexities of artifactual and stratigraphic records provide the framework for interpreting the process of human cultural development in our remote past and how this periodization is relevant or irrelevant to the discussion of the Stone Age of Pakistan and the surrounding regions of South and Central Asia.

The variously proposed systems of organizing the complexities of artifactual and stratigraphic records provides us with appropriate frameworks for interpreting the chronological succession of Paleolithic artifacts at different times. This has been a complex issue because prehistorians dealing with this timeline are faced with a truly novel and daunting problem: How is a vast period of human existence, for which there are no contemporary written records, to be structured? What adds to the difficulty is that no absolute dating techniques were available till very recent times. As a result, a diverse structure of periodization developed whose sequence rested on relative chronology. All these attempts were, of course, Euro-centric if not Eurospecific. When applied to the situation in South Asia, or even to Africa, the fit was not comfortable. This added to some new difficulties and it generated quite a bit of confusion among archaeological circles. As will be seen shortly, the attempts towards dividing the Stone Age into various periods and allocating to them a sequence have been many but this confusion still exists.

The relationship of the level of Paleolithic technology to time has always been among the fundamental concerns to archaeologists and prehistorians. Indeed the initial achievement of the 19th century archaeologists was the establishment of the depth of human antiquity, which altered the scope of human history (see Chapter II.1). The early archaeologists and prehistorians were, however, limited in thought and means. The archaeologists of today have more tools of investigation at their hands that are much sharper and much more precise than those available even a century ago. Some absolute dates have also become available. Nevertheless, many of temporal structures that have been

developed in the past have remained more or less intact and have become central to the practice of paleolithic archaeology and still form the foundation of human prehistory. This makes the pioneering period of the past two centuries quite an interesting study in investigative thought.

This chapter opens with a short history of the conceptions of time in the development of Paleolithic chronology and leads to a review of how the Stone Age in general came to be temporally segmented into various cultural phases, how each phase is to be generally recognized, how the various stone tools traditions relate to these segments, and how the Stone Age tools of Pakistan and other parts of South Asia fit or do not fit in this grand scheme of periodization. A good idea about these matters is essential in appreciating the various finds and their relationship with the development of culture in the Old World. In effect, this chapter channels the material discussed in the several foregoing chapters into a quasi-temporal mold and sets the tone for the closure of the book.

Paleolithic, Mesolithic, and Neolithic: Following the establishment of human antiquity (see Chapter II.1), in the years between 1859 and 1863, the most immediate problem facing archaeologists was how this newly discovered and amazingly long period of human existence should be integrated into the existing three-age system (Stone Age, Bronze Age and Iron Age) for prehistory. While this new section of the ancient history of man was part of the Stone Age, which had already been defined to cover the most recent time before the appearance of metal, it was not clear whether it was simply a matter of stretching the Stone Age back in time or whether a new unit should be created. An important factor was that the length of the newly discovered period of time dwarfed the combined duration of the previously recognized archaeological 'ages'. The resolution of this problem came quickly and received unanimous acceptance in 1865: John Lubbock proposed a division of the Stone Age into "Old" and "New". The OLd Stone Age (*Paleolithic)* was defined as the period when man was contemporary with now extinct fauna; the New Stone Age (Neolithic) was the period "in which the stone implements are more skillfully made, more varied in form, and often polished". It is interesting that, as defined by Lubbock, the two periods were not mutually exclusive. The Neolithic was defined in terms of industry, while the Paleolithic effectively sealed off the newly discovered expanses of human existence from those periods that were already known. The result was a temporal boundary between the Paleolithic and Neolithic.

Without going into details, a transition stage between the Paleolithic and the Neolithic was duly recognized in due course of time and named the *Mesolithic*. Adding this period to the relative chronology of the 19th century scholarship, the Stone Age of Europe as well as the region outside Europe started to be divided into three periods or stages:

1. Paleolithic (Old Stone Age)
2. Mesolithic (Middle Stone Age)
3. Neolithic (New Stone Age)

This division of prehistory proved useful in putting some order in the overwhelming archaeological data that had accumulated over the past one and a half century. The sequential order of these periods and the continuous processes of technological development that they represent were all demonstrated by *assemblages* of artifacts incorporated in a series of geologically stratified deposits, whether deposited by the melting glaciers or by rivers and streams.

Soon, it was realized that the Neolithic could be better defined in terms of social and cultural characteristics rather than stone tools and lithic technologies. The term Neolithic consequently began to be used, especially in archaeology and anthropology, to designate a stage of cultural evolution

characterized by the existence of settled villages largely dependent on domesticated plants and animals, and the presence of such crafts as pottery and weaving. The time period and cultural content indicated by the term varied with the geographic location of the culture considered and with the particular criteria used by the individual scientist. Neolithic was, therefore, taken out of the gambit of the Stone Age.

The Mesolithic period in several areas shows a gradual transition from a food-collecting to a food-producing culture, i.e. From the Paleolithic to the Neolithic, and it is a well-recognized period of human prehistory in Europe. In other parts of the world, however, no such transitionary stage exists and the Mesolithic is not being recognized as a separate stage of the Stone Age. This applies to South Asia as well. Thus, in some areas, such as South Asia, the Stone Age is left with the Paleolithic period only. We shall follow this logic in the balance of this book. We shall, however, occasionally talk about the Mesolithic because it forms a significant part of the Stone Age literature around the world, including South Asia.

A short History of the Study of the Paleolithic Period: The approach of 19th century British prehistorians to the Paleolithic was essentially nonchronological. Rather than attempting to impose a chronological order on this period of human history, the emphasis was on comparing Paleolithic societies with living hunter-gathers in Africa, Australia, and elsewhere. One clear example of 19th-century ideas about the Paleolithic (2) is from the writing of Charles Lyell (1863), who admitted that there might have been “different degrees of civilization in the art of fabricating flint tools”. For Lyell “different levels of culture” were characteristics of contemporary tribes. When he wrote that “those hunters who carved the representation of the mammoth on ivory found in the cavern of La Madeleine in Petrograd may have been far less barbarous than the savages of St. Acheul”, he did not insist that the material from St. Acheul was therefore earlier than the material from La Madeleine.

John Evans (1872) divided the Paleolithic into two periods; “those of the river-gravels and those of the caves, the fauna and implements of which are not in all cases identical”. Although Evans treated the implements from the caves and from the river-gravels separately, he carefully stipulated that “it must not be supposed that there exists of necessity and demonstrable difference in the age of the two classes of relics”. Evans went even further than Lyell in stressing explanations for variability that are not related to the temporal position of an industry. In a fashion that resembles the methods developed by the New Archaeologists of the 1960s, Evans explained assemblage variability on the basis of postdepositional processes, biases in recovery strategy, and activity variants.

For Lyell, Evans, and other 19th-century prehistorians, analogy with living hunter-gathers served as the primary means of classifying Paleolithic materials; remains could be ranked as more or less primitive, just as living hunter-gathers were classed. However, as the ranking of living huntergathers applied to group existing at one and the same time, these prehistorians were not eager to assign temporal significance to the ranking of Paleolithic remains on temporal basis. It is only much later that the ranking of Paleolithic remains by analogy to living hunter-gathers took on an explicitly temporal significance in the work of British prehistorians.

Eduard Lartet was among the pioneers of Paleolithic archaeology and was the first to develop a chronological scheme for the Paleolithic. In 1861 Lartet proposed a paleontological division of the Quaternary (The Quaternary Period is the most recent of the three periods of the Cenozoic Era in the geologic time scale. It follows the Neogene Period, spanning 2.588 ± 0.005 million years ago to the present. The Quaternary includes two geologic epochs: the Pleistocene and the Holocene.) into the Cave Bear period, the Elephant and Rhinoceros period, and the Reindeer period. Several authors reduced Lartet’s scheme to two periods, a period of mammoths and cave bears and a period of reindeer. However, the only lasting effect of Lartet’s proposal was a lingering equation of the Upper Paleolithic with the “Reindeer Age”. In such a usage, the term Reindeer Age expresses an

ethnographic rather than paleontological fact. It denotes particularly the age when the Reindeer played a great part in the life of the European man, for whom it provided food, clothing and the raw materials for a large proportion of his industry. Lartet's chronology is the precursor of the multitude of regional chronologies based on sedimentary profiles, fauna, and microfauna that followed it.
Another important name in connection with the sequencing of Paleolithic is de Montillet (1903). His chronological system was extremely simple. He divided the Paleolithic into four epochs, the Acheulian, Mousterian, Solutrean, and Magdalenian, which, following geological practice, were named for type sites. These epochs were presented in the form of a table where each epoch was correlated with major sites, geology and meteorology, and fauna. Although extremely simple in form, de Mortillet's chronology was built up from a complex theoretical foundation. Two alternative conceptions of the Paleolithic were expressed in his writing: archaeology as culture history and archaeology as a record of human progress through defined stages. A basic weakness in de Mortillet's work was that his chronology simultaneously embodied a series of cultures and stages of evolution. Here Breuil came to his help; he disengaged these two strands. In Breuil's scheme, the 'tree of culture' was represented by the cultures as named by de Mortllet, although with some modification. The 'ladder of progress' was not absent from Breuil's scheme; rather it was embodied in the categories *Lower* and *Upper* Paleolithic. The transition between the Lower and Upper Paleolithic, lying within the realm of evolutionary advance, was outside the cultural sequence. Once this transitionary period was added to the Breuil scheme, the prehistorians of the day more or less settled on the now familiar periodization: the *Lower*, the *Middle*, and the *Upper* Paleolithic.
In the 100 years since Breuil presented the distinction between the Lower and Upper Paleolithic there have been many developments that have affected Paleolithic chronology. These include the increasingly global nature of Paleolithic archaeology, the development of methods of absolute dating, and some expressions of skepticism concerning the inherently progressive nature of human history. Despite these developments, the chronological framework developed in the work of de Mortillet and Breuil remains largely intact.
The Paleolithic: The periodization or the chronological stacking of various stages of the Paleolithic has taken a number of turns and twists during the past two centuries. This history is quite interesting and some of it has already been covered in previous pages. As it stands today, the Paleolithic is divided into three, somewhat overlapping, periods:
1. Lower Paleolithic (*ca.* 2.5 million years ago to to 100,000-300,000 years ago, depending on the region.
2. Middle Paleolithic (*ca.* 100,000-300,000 to 30,000-40,000 years ago).
3. Upper Paleolithic (*ca.* 40,000 to 10,000-15,000 years ago).
Interestingly, the Paleolithic so defined, loosely corresponds with the duration of the geological epoch of the Pleistocene, which is supposed to have begun *ca.* Two million years ago and end *ca.* 10,000-12,000 years ago. Taking this correspondence a little further, we may talk about the Lower Paleolithic in terms of the Early Pleistocene, the Middle Paleolithic that of the Middle-to-Late Pleistocene, and Upper Paleolithic to the terminal Pleistocene. One must, however, understand that technically there is no correspondence between the various stages of Paleolithic and those of the Pleistocene: we are talking here only in historical correspondence.
This division of the Paleolithic into the Lower, Middle, and Upper periods is based on progressive improvement in tool-types, which gradually came to acquire better efficiency in their cutting edge and operating ease. Thus, while Lower Paleolithic period was marked by the use of heavy pebble tools and crudely made hand-axes, the Middle Paleolithic was characterized by lighter tools made on more-or-less standard flakes. The Upper Paleolithic, in turn, was represented by sharp blades, and burins. These three stages are supposed to mark technological communities. The above-described

three-fold division of the Paleolithic proved quite useful in interpreting the Stone Age chronology of Europe and in rationalizing the evolutionary history of human technologies in Africa and Asia. However, as more data became available from these regions, the inapplicability of the European model to the African and Asian situations started to become evident. In order to take care of some of the differences and to accommodate certain anomalies, the European scheme of periodization (Lower, Middle, and Upper Paleolithic) was altogether abandoned for Africa and a new periodization (Early, Middle, Later Stone Age), specific to Africa, was introduced. This periodization has since been accepted for Africa without any reservation.

The situation in South Asia, however, remained in a doldrum. As will be explained shortly, here too an African type periodization was attempted and was partially accepted by archaeologists. But, despite the evident difficulties in applying the European periodization of the Stone Age in terms of Lower, Middle, and Upper Paleolithic, arand cultural advances in human chaeologists and prehistorians working in South Asia somehow found it difficult to unhinge the South Asian Stone Age from the European Paleolithic. As the matter stands to-date, while there are heated discussions and the pious proclamations for the desirability of a South Asian-specific periodization, most of the archaeologists and prehistorians working in South Asia have not yet been able to completely free themselves from the European anchor. The reasons are many, the foremost of them being the preponderance of research work that has been conducted in Europe compared to that undertaken in any part of South Asia. The literature on European Paleolithic is indeed so voluminous that no description or analysis of any aspect of non-European Paleolithic is possible without constantly referring to the Paleolithic parallels of Europe and West Asia. This situation is currently the stuff of archaeological and paleoanthropological textbooks all over the world, and thus cannot be ignored. Thus, before we attempt to describe the Paleolithic of Pakistan and that of the surrounding region, a brief textbook type review of the European Paleolithic is in order, sticking to the European idiom.

The Lower Paleolithic: The Lower Paleolithic is the earliest subdivision of the Paleolithic. It spans the time from around 2 to 2.5 million years ago when the first evidence of craft and use of stone tools by hominins appears in the current archaeological record, until around 100,00 – 300,000 years ago. The Lower Paleolithic is characterized by very early and crudely made stone tools, known as the Pebble Tools, typified by *Oldowan* tools after the site in East Africa where they were first discovered. The Oldowan tool making tradition transformed into a long tool-making tradition in northern Pakistan, generally called *Choppers-Chopping Tools Tradition*. This culture moved into Europe from Africa and split into two parallel traditions, the *Clactonian*, a flake tradition, and the *Acheulian*, a hand-axe tradition. Similar tool-making traditions, to varying degrees, also appeared in other parts of the world except in the Far East and North Eurasia where Choppers-Chopping tools continued to be made and used. The Paleolithic of Pakistan is interesting in this respect because its northern part was predominated by a regional Choppers-Chopping Tools tradition, often called the *Soan Industry*, while the rest of the country was dominated by the Acheulian handaxes and scrapers.

The Middle Paleolithic: The Middle Paleolithic is the second subdivision of the Paleolithic as it is understood in Europe. It broadly spanned from 300,000 to 40,000–50,000 years ago. The Middle Paleolithic spawned a tool making technique known as the prepared-core technique, that was more elaborate than previous Acheulian techniques. This method increased efficiency of tool-making by permitting the creation of more controlled and consistent flakes, which allowed the Middle Paleolithic humans to correspondingly create stone tipped spears by hafting sharp, pointed stone flakes onto wooden shafts. In addition to improving tool making methods, the Middle Paleolithic also saw an improvement of the tools themselves which allowed access to a wider variety and amount of food sources. As a result of both their technology and their advanced social structures, the Middle Paleolithic groups appear to have hunted large game just as well as Upper Paleolithic modern humans

may have likewise hunted with projectile weapons, such as bow and arrows. The use of fire became widespread for the first time in human prehistory and humans began to cook their food during the early Middle Paleolithic (*ca.* 250, 000 years ago). *The Upper Paleolithic:* The Middle Paleolithic was succeeded by the Upper Paleolithic subdivision, which first began around 45,000-40,000 years ago in European context. The upper Paleolithic is considered to be the beginning of the age of the 'modern man', representing the so-called "Upper Paleolithic Revolution". There was a radical change in tool types and tool-making technologies. Several technical advances are in evidence: the invention of nets (*ca.* 22,000 or 29,000 years ago); bolas, the spear thrower (*ca.*30,000 years ago); the bow and arrow (*ca.* 25,000 or 30,000 years ago); and the creation of artwork. Dogs were domesticated by the end of the Upper Paleolithic, sometime between 30,000 and 14,000 years ago.
Archeological evidence from the Dordogne region of France demonstrates that members of the European early Upper Paleolithic culture known as the Aurignacian were the first people to use calendars (*ca.* 30,000 years ago). This early calendar was a lunar calendar that was used to document the phases of the moon. Genuine solar calendars did not appear until the following Neolithic period. It is almost certain that Upper Paleolithic cultures were capable of precisely timing the migration of game animals such as wild horses and deer. This ability allowed humans to become efficient hunters and to exploit a wide variety of game animals.The earliest evidence of artistic expression also comes from this stage in the form of bracelets, beads, rock art, ochre used as body paint and perhaps in ritual. In addition, humans first began to take part in long distance trade between groups for rare commodities and raw materials.
South Asian Three-fold Division: It was a chance collaboration between Bridget and Raymond Allchin, Subbarrao of India and Dani of Pakistan in 1955 that enabled them to agree on the nature of the major cultural divisions of South Asian prehistory as they saw it. They recognized the need for a threefold grouping of pre-Neolithic cultures, but they based their classification on hand-axe industries, flake industries, and microlith industries, respectively. The terms they felt to be most appropriate for these three groups were Early, Middle, and Late Stone Age, in line with those generally applied to the cultural development in East Africa. This agreement was formally ratified in 1963, at a conference held in Delhi to celebrate the centenary of the Archaeological Survey of India, and the Early, Middle and Later Stone Age were declared as the most suitable terms for the major pre-Neolithic cultural phases in South Asia. These divisions fitted the material as it was then known but the chronological boundaries of these Stone Ages were left open.
This classification was initially received with great enthusiasm and to make the whole slew "South Asian" or "Indian", a few additional terms referring to regional manifestations of larger industrial categories were added to this classification. Thus *Madrasian* was used to include the handaxe tradition of the Indian Early Stone Age in peninsular India. *Nevasian* was introduced to designate an expression of the Indian Middle Stone Age in Maharashtra, *Mahadevian* included the Indian Early Stone Age chopper and chopping tools that, to some, were the regional manifestations of the African Oldowan culture from which Indian handaxes independently evolved within South Asia. Similar artifacts from Pothwar, Pakistan, were designated as Soanians. In Sri Lanka, the *Ratnapura culture* referred to the uncertain Paleolithic tool assemblages, while the *Balangoda culture* was a regional expression of the Mesolithic on the island. All this created much confusion without illuminating anything (3). Amusingly, through all this frenzy, everyone continued searching stoner tools that typified the European Lower, Middle, and Upper Paleolithic and force-fitted them in the established European scheme.
The periodization of the South Asian Stone Age, and the terms used to describe its various phases underwent several other changes since then. When Upper Paleolithic industries were positively identified in several regions of India and Pakistan, and the related sequential changes of typology and

climate became clearer, the terms Lower, Middle and Upper Paleolithic and Mesolithic came in vogue again and became appropriate once more. At a conference held in Bombay in 1972 on *Radiocarbon Dating and Indian Archaeology*, the question was again discussed, somewhat inconclusively, and strong arguments in favor of Lower, Middle and Upper Paleolithic were advanced. The use of these terms to describe the subcontinental Stone Age became common-place once again. At the same time, both Lower, Middle, and Upper Paleolithic and Early, Middle, and Later Stone Age continued to be used interchangeably and often indiscriminately. As the things stands now, both sets of the terms are somewhat arbitrary and over-generalized. They are based primarily upon typology, technology and stratigraphy, and the extent to which these factors relate to ecological and cultural developments is still largely hypothetical, although as we shall see, it is sometimes possible to break through this barrier and achieve a rather more complete picture of the community behind a particular industry or group of industries.

Conceptually, there are a plenty of differences between the two systems of classification but in practical terms both can be accommodative of each other. For example, there is very little material difference between the Early Stone Age and the Lower Paleolithic. The Early Stone Age is simply more inclusive than the Lower Paleolithic. It is also not rigid in its temporal boundaries. Similarly, in historical context the Middle Stone Age is not very much different from the Middle Paleolithic except that the former takes in a broader and flexible temporal horizon than the latter. The major problem is defining the South Asian Upper Paleolithic or the Later Stone Age. In order to avoid unnecessary arguments, some prehistorians working in South Asia have started to describe the Stone Age in terms of the Early, Middle, and Later Pleistocene instead of the different subdivision of the Paleolithic or different stages of the Stone Age. This approach is equally satisfactory, probably more so.

There have been a few attempts to completely unhinge the sequencing of South Asian Stone Age from that of European and African Stone Age. For example, in 1973, A.K. Ghosh, echoing Allchin, Subarao, and Dani, pointed out that the Paleolithic culture complex of the subcontinent might broadly be divided into three basic chrono-cultural elements: pebble-core, flake, and flake-blade elements. According to him, the terms are based on culture-traditional units placed in the sequential framework, both geological and archaeological. The whole scheme broadly has an all-India character, though of course at places regional variations are marked. Another proposal is what Clive Gamble proposed in the European context, namely, a distinction between a pre-35,000 years ago as *early* paleolithic and after that date a *late* paleolithic. This has been particularly in context of the Pothwar plateau and advocated by Rendell, Dennell and Halim: “The Early Paleolithic in the Soan and Pothwar is defined in this study simply as being earlier than 30,000 years ago; it cannot at present be sub-divided into chronological stages defined by the presence or absence of certain items such as (Acheulian) handaxes, and (Levallois-Mousterian) tortoise and disc-cores. What is clearly needed are examples of these items in secure geological contexts that are amenable to absolute dating” (4). Where do we stand now? The important thing in all these classifications is the availability of well-dated contexts, and these are not available in any adequate numbers. Till such contexts are reasonably plentiful in various parts of the subcontinent, it may be less confusing to stick to the labels of the Lower, Middle and Upper Paleolithic or adopt the more inclusive but somewhat diffused terms, the Early, Middle, and Late Stone Age, knowing full well that the respective temporal limits are not rigid and that they need not necessarily show any clear correspondence with the Lower, Middle, and Upper Paleolithic of Europe.

Periodization of Pakistan’s Stone Age: Notwithstanding the general acceptance of a threefold division of the Paleolithic of South Asia into the Early, Middle, and Late Stone Age, or the Lower, Middle, and Upper Paleolithic, Pakistan’s Stone Age differs quite a bit from that of India and, of

course, that of Europe and Africa. The presence of a robust technological culture of pebble tools, namely, the pre-Soan industries in northern Pakistan and almost a total absence of it in India is one example of such a difference in the Early Stone Age or the Lower Paleolithic. The discovery of very early stone artifacts in northern Pakistan, going back to as far as 2 million years, is in stark contrast to the Paleolithic record of India where the presence of earliest stone artifacts do not go beyond 350,000 years ago. This does not mean that India was devoid of the presence of hominins prior to this date but it does mean that we cannot study the archaeology of the two regions together when they are geographically and archaeologically so apart.

Similarly, there is no recognizable Upper Paleolithic horizon, as defined by a predominance of long blades, burins, and microliths, in India while an argument can be made for its presence in Pakistan. A pronounced and vigorous blade industry, based on chert nodules as raw material, is evident over a large area of Sindh but we do not see such an industry anywhere in India beyond a diffused bladelet industry and this too based on other types of raw material. Moreover, the absence of a clear and well-defined Mesolithic period in Pakistan but its prolonged presence over a large part of India could be considered still another aspect that distinguishes Pakistan's Paleolithic from that of peninsular India. All this must give us pause in applying a scheme of periodization that might be applicable to India but cannot be applied to Pakistan or *vice versa*.

In view of this situation, we propose to deal with the Stone Age of Pakistan under five loosely defined paleolithic stages, comprising of an equally broad and diffuse sequence:

• The pre-Pleistocene Paleolithic record, i.e., the earliest pebble tools of northern Pakistan. (the Riwat and Pabbi Hills findings).
• The Early Stone Age, or the Early Paleolithic, such as the early Soan industry and the early Acheulian tools tradition in the Pothwar region and probably in southern Sindh..
• The Middle Stone Age, including all what is traditionally dealt with under the Middle Paleolithic in other parts of the world. This would, evidently, include flake industries as well as the continued use of choppers-chopping tools and advanced Acheulian implements. This is an ill-defined stage all over the world, it is so in Pakistan as well.
• The Late Stone Age, including the blade industry, which is considered to be a hallmark of the Upper Paleolithic in Europe and West Asia.
• The microlith assemblages, which is universally considered a separate phase in early human culture. Since there is no temporally definable Mesolithic period in Pakistan, this period must be defined in terms of a cultural transition rather than a distinct paleolithic culture based on lithic technology.

The *earliest Paleolithic stage* in Pakistan is represented by the discoveries of pebble tools at Riwat and its extension at the Pabbi Hills. This period covers the later part of the Pleiocene and the early part of the Pleistocene, ranging from *ca.* 2.1 million years ago to *ca.* 700,000 years ago. These discoveries are, however, controversial because the time frame assumed for the strata where these artifacts were found does not fit in traditionally accepted model for human origin and dispersal in Eurasia. It is understandable that by accepting the Riwat and Pabbi Hills's discoveries without providing an explanation for this extraordinarily early date for their appearance or promulgating an alternative hypothesis for human origin and its dispersal in South Asia would be tantamount to turn over the well-arranged archaeological apple cart. This resistance is, however, slowly weakening as new research has also turn up artifacts of comparable age elsewhere, such as at Dminisi in Georgia.

The *Early Stone Age* or *the Lower Paleolithic* is the oldest documented period in human history, practically ranging from *ca*. 700,000 to 300,000 years ago. A well-dated site in the Soan Valley represents this period in Pakistan. The *Middle Stone Age* is also a long period, stretching from 300,000 years ago to probably 50,000 years ago. A large number of assemblages belonging to this period has been recorded in Pothwar, Peshawar Valley, Sindh, and recently in the Thar Desert. Both of these periods more or less correspond technologically to the Lower and Middle Paleolithic of Europe, respectively, although their timeframes may differ.

The *Later Stone Age* of Pakistan represents the most recent Stone Age period, just preceding the development of agriculture and pastoralism in Baluchistan; a time period between 50,000 to 15,000 years ago. This time period of Pakistan's Stone Age encompasses the stone industries that are the hallmark of the Upper Paleolithic in Europe. A relatively short segment of this period just before the appearance of agriculture and sedentary living is characterized by microliths and composite tools. This can be considered an extension of the Upper Paleolithic or, alternatively, treated as the Mesolithic of Pakistan.

It must be emphasized here that not all of these periods are historically of equal importance. For instance, the Mesolithic period, if there was any such definable period in Pakistan, was spread over a large span of time, having its beginning in the Later Stone Age (or Upper Paleolithic) and running well into the Neolithic. Nevertheless, this stage was of extreme cultural importance for its transitional character from the Stone Age to the beginning of sedentary life of agriculture and animal husbandry. For this reason, we are devoting a full section to this stage of the Stone Age of Pakistan. In the same vein, the earliest stone artifacts from Riwat and Pabbi Hills in the Soan Valley, although somewhat controversial, are of utmost theoretical importance as they bear upon the origins and spread of hominins in Eurasia. Consequently, we devote a considerable space to these discoveries.

Although not agreed upon universally, the above mentioned sequential framework provides us with a good working basis for studying the large assemblage of tools that have been collected from diverse locations in the North as well as in the South. Evidently, it is difficult to fix a definite dividing line for the periods so remote in time, especially when so few independently arrived absolute dates are at hand.

Despite the five-fold division of the Stone Age of Pakistan outlined above, we should not be averse to referring to the well-entrenched conventions in the vast Paleolithic literature that has accumulated all over the world. Pakistan's Paleolithic may significantly differ from that of Europe, West Asia, Africa and India, but it also shows a number of parallels with them. Thus, we do not see any reason to completely divorce ourselves from the rest of the world in order to accommodate a few, although quite important, Paleolithic peculiarities of this land.

The purists may argue as to the exact meanings of the "Early", "Middle", and "Late" Stone Age or the "Lower", "Middle", and "Upper" Paleolithic; they can quarrel about the equivalence of the "Early" with the "Lower" and of the "Late" with the "Upper"; or try to find the answer to the question if three divisions were actually "periods", "phases", or "stages". Some may even question the introduction of previously unheard of Late Pliocene period "very Early" stone tools, or object to the inclusion of the Mesolithic in the Paleolithic or even in the Stone Age. For our purpose they represent the successive cultural and technological stages through which the early humans and their ancestors passed in the very early history of mankind. In this connection, it must be pointed out that these four divisions plus

the one prior to them, do not represent any hard boundaries in time and space but are rather defined with fuzzy extremities that tend to change as one's perspective of looking at them changes. Also, the transition from one stage to another is not sudden. The point to keep in mind is that some recognizable

In South Asia, we try to describe our Stone Age in terms of Early, Middle, and Late Stone Age but constantly looking for the Lower, Middle, and Upper Paleolithic. A clean and orderly sequence is, therefore, not possible; neither for India nor for Pakistan and we need to conceptualize the Stone Age in this part of the world in terms of a continuum of cultural change. By necessity, the chronology of this change must be regional and the relationship of one culture with the other with a country or a geographic region at best tenacious.

stratigraphic profiles of artifacts are available and these indicate a clear evolution of lithic technology from the earliest to the Lower, the Middle, and the Upper Paleolithic, transitioning to the Neolithic through the Mesolithic, or if one prefers, from the Early to Middle to Late Stone Age, flanked by the very early stone tools of the late Pliocene at one end and the miocroliths of the Mesolithic Transition at the other end.

Geographically, the various stages of the Stone Age were fairly widespread in Pakistan. The large area, spanning from the Pothwar Plateau in the North to the Las Bela plain in the South, show a robust presence of man in their respective Lower, Middle, and Upper Paleolithic time frame, although the vey early Oldowan type artifacts are visible in

the Siwaliks only. While the Pothwar Plateau furnishes us with a clear evidence for the presence of man in the prePleistocene, the Sanghao Caves in the Peshawar Valley and the Dry Zone of Sindh are witness to his activity during the Middle and Upper Paleolithic. Similarly, the microliths of the Mesolithic transition is strewn all along the sea coast as well as on the lakeshores in Sindh and the valleys of the Soan and Haro in the north of Punjab.
The Stone Age of Pakistan covers a nominal time period between 2 million years ago to 10,000 years ago. The sequential order of the four main stages plus one tansitional one, the continuous process of technological development that they represent, and their regional divisions within the Greater Indus Valley are all demonstrated by assemblages of artifacts incorporated in a series of geologically stratified deposits, some laid down by rivers and

streams in many parts of northern Pakistan, some left behind in caves in the Peshawar Valley, and some scattered around the 'factory areas' of the chert outcrops in Sindh. Noted and studied by a small band of geologists and prehistorians for well over a century, they provide the framework or skeleton of early prehistory of Pakistan.

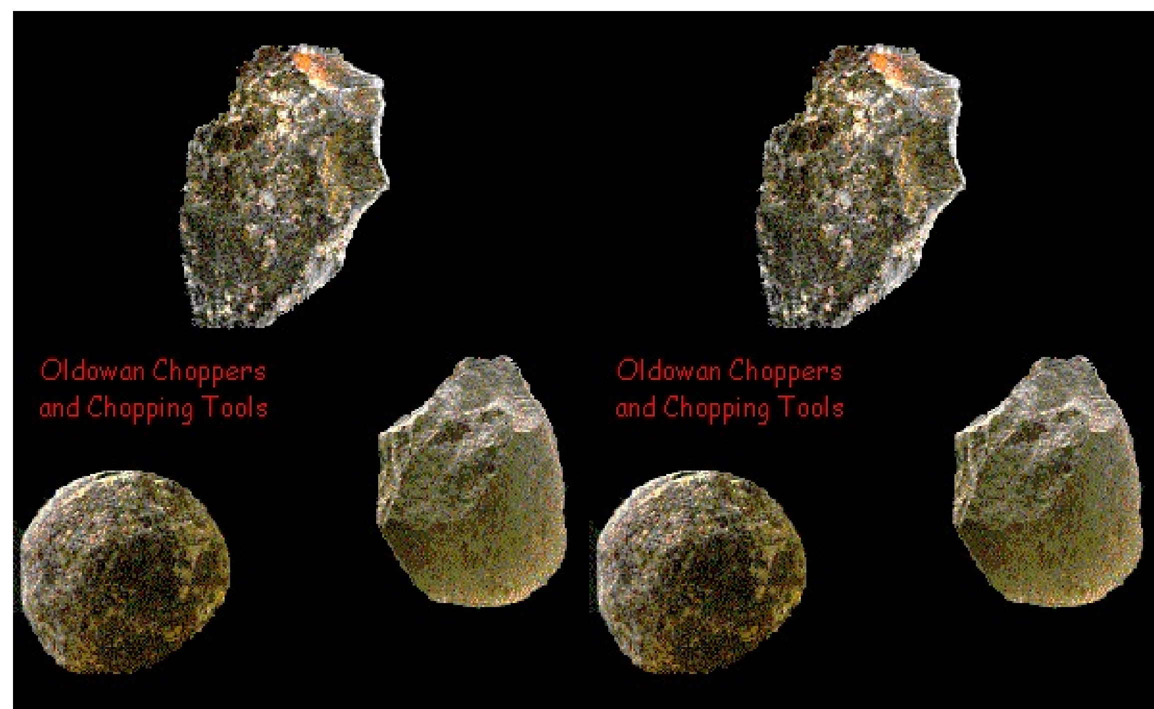
A Parting Thought: While we talk about a four- or five-fold sequence for Pakistan on the basis of 'periods' or 'stages' and try to classify each artifact into this or that category, we hear a constant refrain in the background that reminds us about the evident ambiguity of any classification. It is a fact that the areas of Paleolithic interest in Africa, west Asia, and Europe have been researched extensively

while our knowledge about Pakistan’s Paleolithic past and that of its borderlands is only spotty.

The sheer spread, depth, and quantity of data are no doubt impressive enough to demonstrate the general significance of the Paleolithic period in the pre-history of Pakistan. At the same time, it would be difficult not to concede that, despite more than a century of research, the sum total of our historical knowledge beyond the tools has been anything but marginal. The result is that in spite of the relentless efforts of archaeologists and paleoanthropologists of the past in packaging the Paleolithic developments in South Asia into some sort of threefold sequence and tying it up with that of East Africa, West Asia, and Europe, the success has been only marginal. This ambiguous and tentative situation is reflected in this book also. In the end, there is no use pretending that we know enough of the Stone Age of this area as to be able to discuss it in terms a precise sequence of technological or chronological progression. The sequence recommended in the above should, therefore, be taken merely as signposts on our path of exploration.

In spite of persistent efforts in the past, the lithic sequence in Pakistan, in fact in all of South Asia, still remains undefined. It is, therefore, difficult to say as to when the Middle Paleolithic in southern Pakistan began and when did it end. There is no set of tool types in Pakistan and the borderlands that can be defined within a Lower, Middle, and Upper Paleolithic period, as is the case in Europe, or an Early, Middle, and Late Stone Age, as is the case in African Paleolithic archaeology. In South Asia, we try to describe our Stone Age in terms of Early, Middle, and Late Stone Age but constantly looking for the Lower, Middle, and Upper Paleolithic. A clean and orderly sequence is, therefore, not possible; neither for India nor for Pakistan and we need to conceptualize the Stone Age in this part of the world in terms of a continuum of cultural change. By necessity, the chronology of this change must be regional and the relationship of one culture with the other within a country or a geographic region at best tenacious.

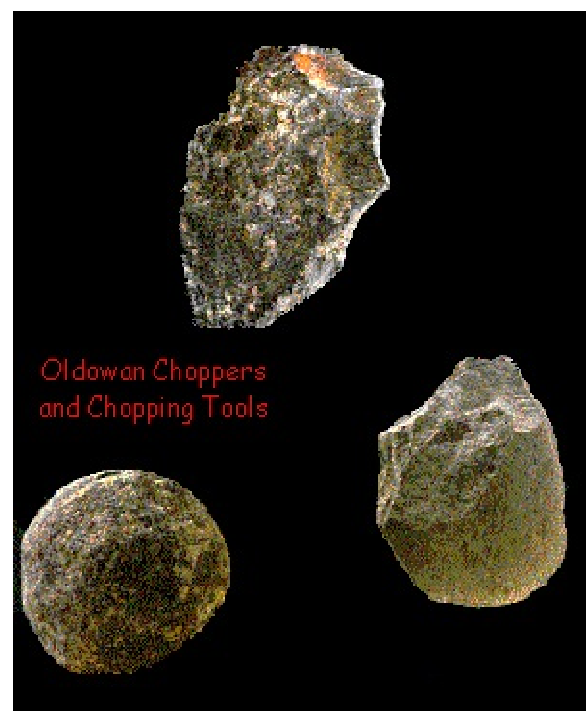
VI.2. The Earliest Stone Artifacts from Pakistan



**Pebble Tools from Olduvai,
East Africa.**

What types of artifacts can be recognized as Th.e earliest stone tools in Pakistan? Intuitively, we must expect to find the same type of tools as those found elsewhere in the Old World, belonging to the same early beginning of man. This puts us face to face with Oldowan tools from East Africa. These early tools could consist of pebble tools, that is, large cores and large unretouched flakes. Indeed, our intuitive expectations are largely met in the Pothwar region of Pakistan where quite a few stone tools have been found which appear to be very, very old and resemble those of Great Rift Valley of East Africa: A few of them have been securely dated to 1.9-2.1 million years ago.

These dates belong almost to the same horizon as that attributed to the earliest stone tools in East Africa where the presence of tool-making hominins has been known from almost 2.5 million years ago. The assemblage of these tools from Pothwar, sometimes referred to in archaeological circles as the ‘pre-Soan tools’, is rather small but what is known about them indicates their broad similarity with those of Oldovai in East Africa, the earliest stone artifacts ever known in the world. Since any designation connecting these tools to East Africa could be contested, we shall call them the Earliest Stone Tools of Pakistan instead of getting into a semantic discussion of their name and other aspects which may be of interest to archaeologists only.



Earliest Stone Tools of Mankind: The very first stone tools used by humans and their hominin ancestors were probably naturally broken, sharp-edged rocks that were casually picked up, used and discarded. There is probably no way that we will ever know how long this type of behavior persisted in human prehistory. At some point, however, early hominins began purposely selecting specific raw materials, and making their own sharpedged stone tools. The earliest manifestation of this behavior has been loosely called the *Pebble Tool Tradition*, because it entailed the sharpening of pebbles and small cobbles through the removal of one or several flakes. These *core tools* most likely functioned as multipurpose hammering, chopping, and digging implements. Probably the most important tools in the Oldowan tradition were sharpedged stone flakes produced in the process of making the core tools. These simple *flake tools* were used without further modification as knives. They would have been essential for butchering large animals, because human teeth and fingers are totally inadequate for cutting through thick skins and slicing off pieces of meat. Evidence of their use in this manner can be seen in cut marks that still are visible on bones. Although it was thought for years that the sharpened pebbles were the desired end product, new evidence from the analysis of microscopic wear patterns on the flakes that had been considered waste products indicates that the flakes may actually have been the tools, used for general purpose cutting, and the core probably the waste.

In archaeological circles, these stone artifacts are known as the Oldowan and, as stated above, they are significant for being the earliest stone tool industry in prehistory, being used from 2.6 million years ago up until 1.7 million years ago, when it was followed by the more sophisticated *Acheulean* industry. The term "Oldowan" is taken from the site of Oldovai Gorge in Tanzania, where the first Oldowan tools were discovered by the archaeologist Louis Leakey in the 1930s. These tools were dated to around 2 million years ago. Oldowan tools are sometimes also called "pebble tools," so named because the blanks chosen for their production already resemble, in pebble form, the final product. These simple tools are sometimes subdivided into types, such as chopper, scrapers and pounders, as these appear to have been their main uses. Some contemporary archaeologists and paleoanthropologists prefer to use the term "Mode 1" tools to designate Oldowan tools, with "Mode 2" designating Acheulean ones.

Although first discovered at Olduvai Gorge in Tanzania, the earliest evidence of such simple stone

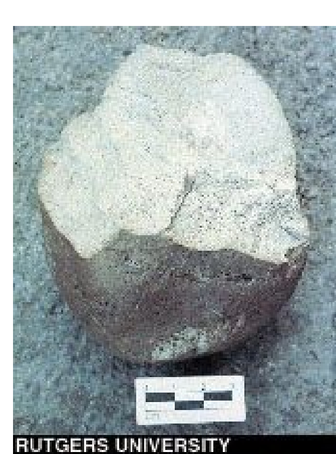
tools come from Goan in Ethiopia. These arti



This is a Mode 1, or Oldowan stone tool from the western Sahara.

facts were securely dated to 2.6 million years ago. Since no hominid remains were found with these stones at Gona, it is not known for sure which hominin species actually created and used these tools. They are often associated with the species *Australopithecus garhi*, or with early species of Homo such as Homo *habilis*. Early Homo *erectus* appears to inherit Oldowan technology and refine it into the Acheulean industry beginning 1.7 million years ago.

The Earliest Stone Tools from South Asia: The earliest stone tools of South Asia which remotely resemble the Oldowan tools of the Great Rift Valley of East Africa come from the Siwalik region of Pakistan, of which Pothwar Plateau is a part. These artifacts are generally looked upon as a collection of an ill-defined Mode 1 industry of uncertain sequence and have for long been a mere curiosity of no significance in the archaeology of South Asia. Neverthelessss, several core tools of this type have been collected and a



World's oldest stone tool, about 2.5 million years old, from Afar region of Ethiopia (Rutgers University**)**


Oldowan chopper from Swaziland, South Africa

few of them have been securely dated. In general, these tools, like those from Oldovai, consist of split pebbles and large flakes made from crudely splitting of large pebbles. All are rolled, indicating that they were made or used elsewhere, probably the upper reaches of the Siwaliks, in the shadows

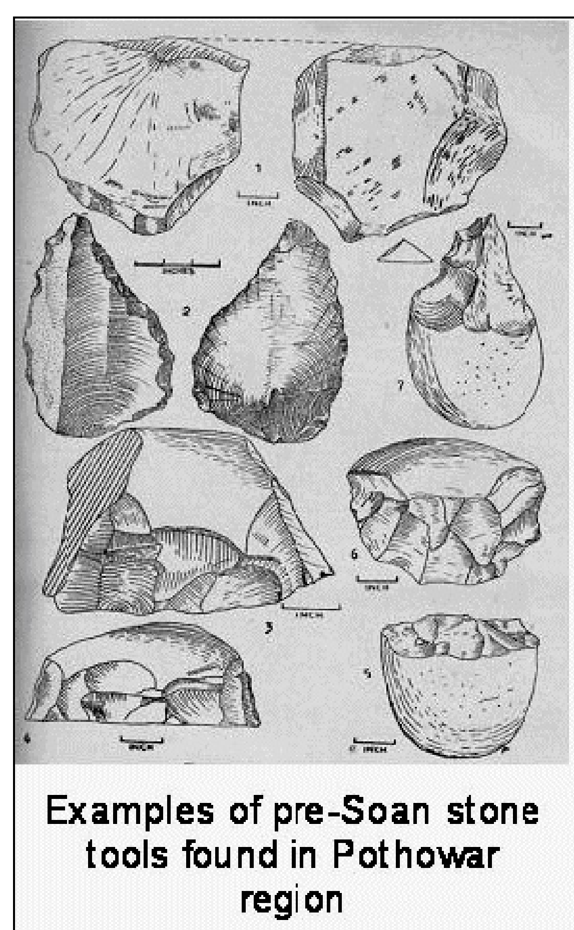
of the Himalayas. Since these tools are heavily rolled, their sharp edges are blunted to the extent of being hardly recognizable. They represent no specific South Asian tool

making tradition except that they indeed look 'primitive' and have been described as such.

Due to a high rate of ongoing erosion and neo-tectonic activity, Siwalik sediments have not yielded stratified early Paleolithic material of such integrity as is known from other regions in the Old World. Not only do these tools reveal different degrees of abrasion, but as surface finds they cannot certainly be directly associated with any specific deposits. These difficulties have prompted some archaeologists to even deny these stones the status of an artifact. Stile (5), for example, suggests that these may not be tools at all and that they may be of natural origin, formed by high intensity contact with moving pebbles and boulders in rivers during flood seasons. Even when these tools were admitted as a legitimate group of man-made artifacts, their age was assigned not earlier than 200,000 years ago as recently as 1974 (6).

This criticism held sway for quite a while in archaeological circles because a considerably earlier dates simply did not fit in the generally accepted picture of human evolution and hominin dispersal in South Asia. The matter is still not resolved but at least the dates are no longer in doubt. In the mealtime, some other similarly early dates became available from other parts of the world, such as those from Georgia and from Java, and the discoveries from Pothwar ceased to be so outlandish.

This change in attitude took such a turn when two securely dated discoveries become available through the research work by the members of the British Archaeological Mission to Pakistan during the early


Examples of pre-Soan stone tools found in Pothowar region

Some examples of the Pre-Soan tools from Pothwar

1980s and a lesser known discovery by Salim in
1993. The significance of these discoveries is seen comparable to the discoveries in China, Java and western Asia and they deserve a somewhat expanded treatment. This chapter is, in effect, devoted to this task.

British Archaeological Mission in Pakistan: The British Archaeological Mission to Pakistan, under its Field Director Professor Robin Dennell, carried out research into the Palaeolithic of Pakistan in the 1980's and 1990's. The first part of this work (1981-85) was based in the Soan Valley, near Islamabad, and resulted in the revision (with his geological colleague, Prof. Helen Rendell) of the Pleistocene and Palaeolithic sequence established by de Terra and Paterson in the 1930's. This phase of fieldwork also involved the excavation of an open-air settlement ca. 45,000 years old, and the discovery of stone artefacts almost two million years old at Riwat. This research was published as a monograph "Pleistocene and Palaeolithic Investigations in the Soan Valley, northern Pakistan" (British Archaeological Reports S544).

The second part of this research involved six seasons (1986-90 and 1999) of field survey and excavation in the Pabbi Hills, which comprise a long sequence of river- and floodplain deposits between 2.5 and 0.5 million years old. This research resulted in the collection of over 40,000 fossil specimens from over 600 places, and these provide one of the best accounts of the fossil record of a riverine and flood-plain landscape, as well as the basis for a detailed biostratigraphy of the Early Pleistocene in southern Asia. Although no hominid remains were found, over 350 stone artifacts were found, many of which are believed to be derived from fossil-bearing deposits and may thus be up to two million years old.

Dennell and Rendell mainly focused on two or three locations (7-17). At Riwat they recovered several artifacts, some of which could be independently dated to ca. 2 million years ago. At Pabbi Hills the recovered artifacts and animal fossil bones were dated between 1.0 and 1.5 million years ago. Both of these discoveries were revolutionary and not in line with the then well-accepted notions of human dispersal in Eurasia. The credibility of these discoveries was however augmented when the same researchers discovered stone tools at two other Soan Valley locations which could be positively dated to 500,000-700,000 years ago. While the tools from the latter sites do fall in the category of the Early Acheulian, most of the tools discovered at the formerly mentioned sites are crude pebble tools, having strong resemblance to the tools from Oldovai in East Africa and belonging more or less to the same timeline, i.e., *ca.* 2 million years ago. This put the Early Stone Age of Pakistan under a different light. One important consequence of these dates and comparative evidence is that these artifacts have surprisingly emerged as contemporary to the oldest stone tools ever known, that is, the Oldowan assemblages of East Africa

Earlier Research and the Discovery of the Earliest Stone Tools in Pothwar: Dennell and Rendell were not the first to locate such artifacts of extreme antiquity. The stone artifacts of truly old age of humanity and resembling those of humans' earliest past in East Africa were not unknown in Pothwar, especially in the Soan Valley; de Terra and Paterson had already described them as early as in mid 1930s. Rendell and Dennell's work only provided a much needed validation. When de Terras and Paterson visited Pothwar in 1938, small sections of Boulder Conglomerate were exposed from where they collected some rolled artifacts; number of artifacts are not reported by them but they came from at least 12 sites including one near Jammu in Kashmir. They named them Pre-Soan. These flakes are large in size and have plain striking platform. At present little is known about these artifacts and it is difficult to say whether they have any relation to succeeding handax tradition or to the pebble tools resembling the Olduvai.

De Terra gives a brief description of these artifacts as split pebbles and large flakes of quartzite. Patterson, who studied them in some detail, describes them as big worn flakes with plain striking platform and low angles. To judge from Paterson's description, there are large as well as small flakes all showing signs of rolling. They have prominent bulbs of percussion indicating stone hammer technique. There are indications of flake scars on dorsal surfaces and are thick in section. Some tools were obtained by fracturing pebble in half, and therefore are thick all around. Others were made by chipping several flakes off the pebble, leaving the core with more than one sharp edge. Such tools were found at Malakpur, Adial, Chauntra, Kallar, and Chaumukh, all in Pothwar (6). De Terra and Peterson distinguished their collection as distinct from those collected from the surface or within the Boulder Conglomerate of 2nd glaciation of Kashmir, which Paterson attributed to the Middle Pleistocene. In later years the geological studies of large exposed horizontal areas made it possible to collect more material such as 98 artifacts collected by Salim (6) from within Upper Siwalik Conglomerate from one site alone. No date was, however, possible to be obtained and in the absence of any independent date, Salim assigned them a relatively recent date. In 1993 Salim again made a collection near Rawalpindi along the GT Road. At the sites of Gurha Sahan and PS-57, stone tools were found embedded in the Pinjor bed of the Siwaliks, which could be dated to 2.0-2.4 million years ago. Stone tools reported in the Jammu and Himachal sections of the Siwalik hills seem to belong to about the same age. Although the secure dates are still not available but on the basis of the geological formation from where these tools were extracted, they were assigned quite an early date, in the time horizon of 1.5 to 2.0 million years ago.

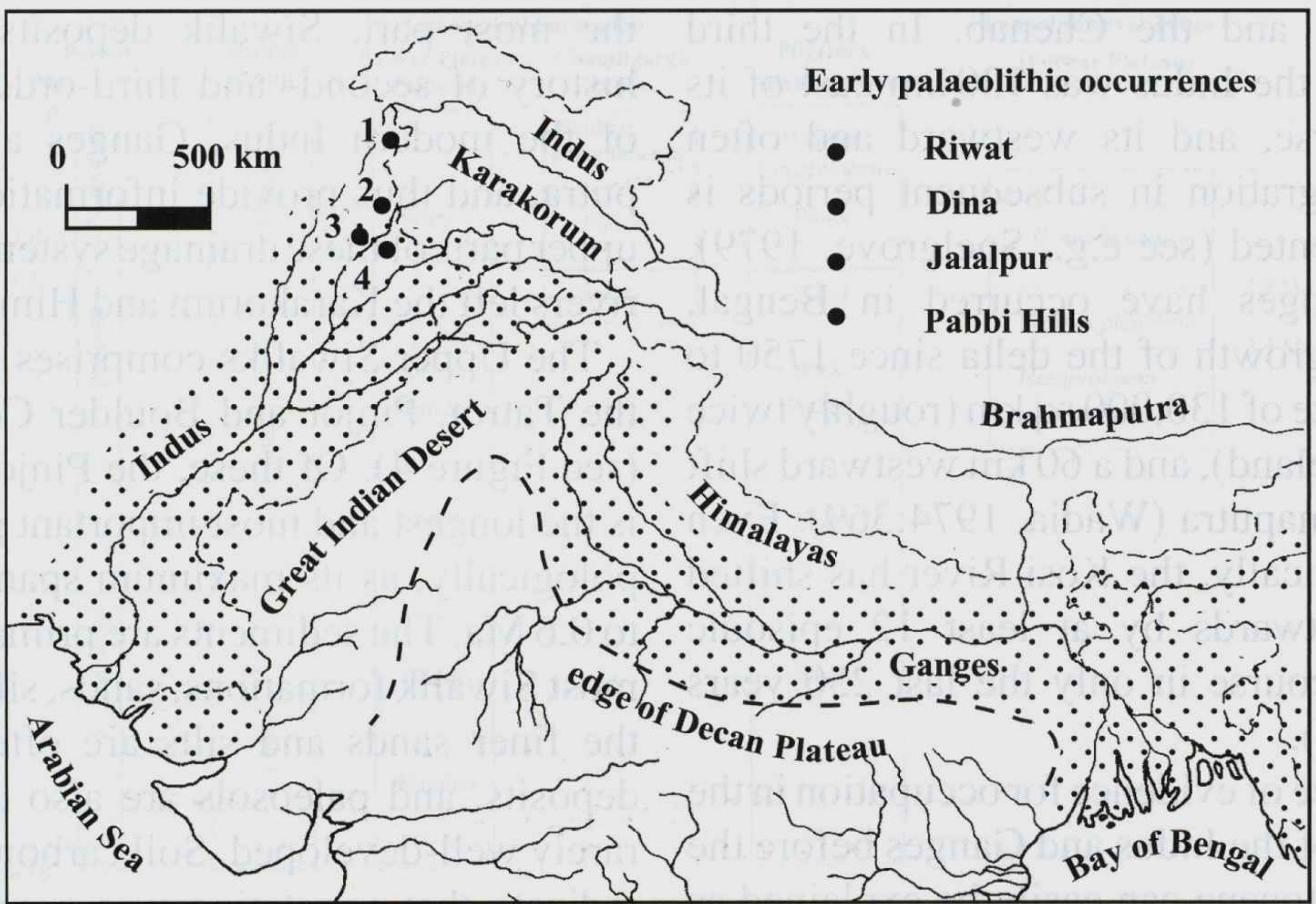
With this background, we now proceed to describe the findings at Riwat and Pabbi Hills in some detail. Some aspects of these finds, especially the geographical setting of the sites, have already been discussed elsewhere in this book; here we are to examine the issue of dating and the artificiality of the

tools, along with other issues that are pertinent to the ongoing debate.

Discoveries at Riwat: As stated in Chapter V.3, the site is about 5 km from Riwat town, near GT Road Milestone 163. Here, in 1983, members of the British Archaeological Mission to Pakistan's Pothwar Project, working in collaboration with the Department of Archaeology of Peshawar University and the Geological Survey of Pakistan found a group of artifacts in Siwalik deposits, which were subsequently dated by the Paleomagnetic method to 1.9-2.1 million years ago (7,12,21). Their absolute date was dependent on the date
nificance and it is often considered the principal discovery at Riwat. It was a piece of flaked quartzite protruding from a cemented gritstone conglomerate near the base of a 70 m deep gully. In view of the researchers, this piece had clearly been flaked before it was incorporated into the gritstone. It also showed little evidence of rolling or abrasion, and had been flaked eight or nine times in three directions; flake scars and ripple marks were clear, and some flakes showed a bulb of percussion at the

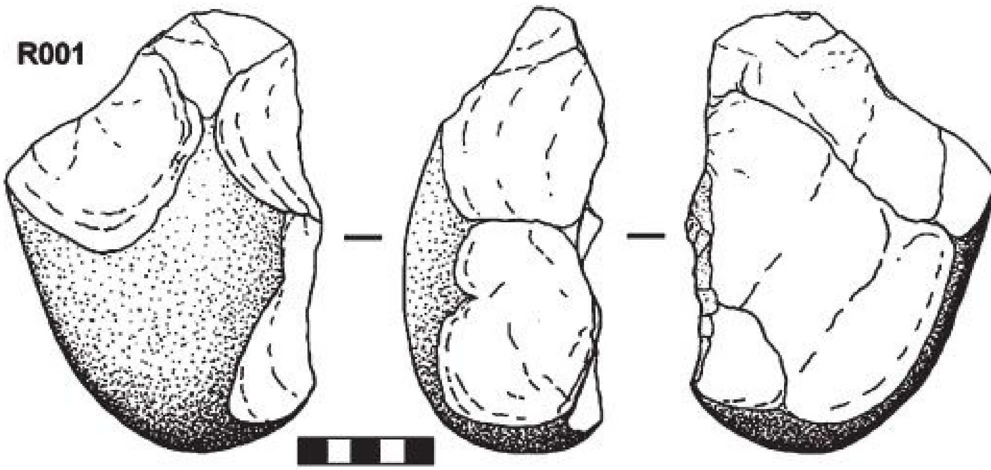
of the gritstone-conglomerate bed in which the atriacts were founded imbedded. This gritstone bed is a part of the folded strata of the Soan geo syncline which originated between 2.1 and 1.9 million years ago. The authors' general conclusion was "the geological horizon in which the arti facts were embedded is 2 million years old". Some of these tools were clearly man-made and were all in fairly fresh condition. They were shown to have been an integral part of the deposit in which they were found, incorporated into it from the time it was formed.

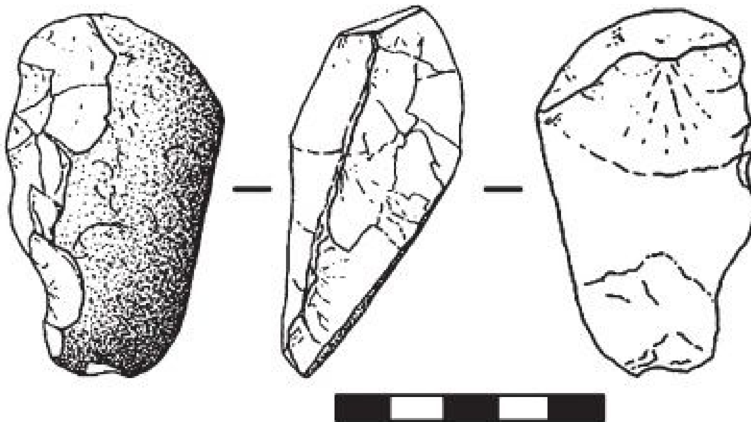
Of all the artifacts collected at Riwat, one particular piece, desig nated as R001, acquired special sig

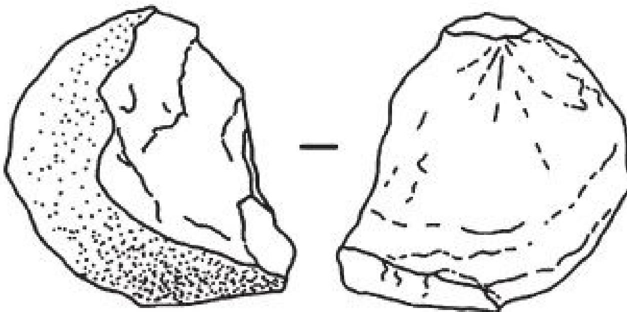


Map, showing early Paleolithic sites discussed in this chapter

point of impact. In other words, it had all the characteristics one would expect of an intentionally flaked stone. It is made from a quartzite pebble, with the clear intention of producing a tool with a point and two sharp edges. The butt fitted the hand so that the tool balanced in a suitable way for heavy chopping or hacking. The initial flakes that blocked out the form had been struck off in a controlled manner in at least three directions, and this had been followed by further trimming - a sequence that could not have happened naturally. “It was found securely imbedded in a gritstone bed from which it had to be pried out with some diligence”.







According to the researchers, further inspection of large blocks that had become detached from the gritstone horizon produced twenty-three pieces that showed evidence of flaking; of these, four were regarded as intentionally struck (22). K008 is a small flake, with only 15% of its cortex remaining, and some indication of retouch. K010 is also a small flake, in surprisingly fresh condition. K011 is a core with two well-defined flake scars and was struck in two planes. R014 was particularly convincing, in authors' opinion: a massive flake was detached from one side; leaving extremely clear bulb of percussion, and further seven smaller flakes had then been removed on one side. There are two

The three main specimens from Riwat
(Dennell**)**

more pieces which the researchers tend to include in this category while the rest of the assemblage is of less determinate. In the Riwat locality no fossils of any kind were found, as the soil chemistry unfortunately was not conducive to the preservation or fossilization of bone.

Identification and Context: The assemblage is extremely small, and discussion normally focuses on three pieces (see the Figure above). The main one (RO01) is a large core (168 x 118 x 74mm) that was struck eight or nine times in three directions; there are clear impact points and ripple scars on at least three of the flake removals (22). The size of flakes removed (average 6.6 x 6.2mm) is within the range of those seen at Olduvai Gorge, Bed I. The authors state, “several Paleolithic archaeologists (including several far more authoritative on early Paleolithic lithic technology than the author) who have seen a resin cast of this object have accepted it as demonstrateng unambiguously intentional flaking”. RO01 was found firmly embedded in an outcropping gritstone/conglomerate horizon near the base of a gully 70 m. When found, it was obvious that some flake scars extended into the outcrop, and thus the piece could not have been flaked after exposure. After the piece had been removed, the socket showed the flake scars that were on the core (22).

A second piece (R014) is a large flake (132 x 79 x 58 mm) that had been struck from a cobble; there is a clear bulb of percussion and associated ripple marks on the dorsal face, and at least three flakes were struck along the side (22) creating an edge straight in side view. There were eight scar surfaces resulting from flaking in three directions (5,13,22). It was found in 1988 in a freshly-eroding vertical section 50 m from the core RO01. It is a flake (59 x 45 x 20mm) with a clear positive flake scar on one face, a negative one on the other and evidence of flaking from three directions (22).

Dating: In order to date the artifacts, which were in conglomerate beneath 68 m of sediment, samples were collected for paleomagnetic analysis from sections just above and below the conglomerate. Other samples were taken from 45 stratigraphic levels. The analysis of these samples by the Oceanography Department of Southampton University showed that all but the lowermost samples exhibited characteristic reverse polarity magnetism. The sediments were deposited at a time when the earth's magnetic field was directed south of the equator, namely prior to the time of the BrunhesMatuyama boundary of 0.73 million years ago. A previous paleomagnetic study of the Dina section located this boundary just below the level where a single handaxe had been found.

More precise dating of the artifacts was obtained by geological analysis of the folded strata of the Soan syncline. The Soan Valley consists of a syncline that dips gently at ca. 10-15° on its southern side, but rears up almost vertically on its northern limb. Its stratigraphic sequence and age were investigated very thoroughly by American geologists whose primary interest was in the evolution of the Himalayan forelands. They concluded that the Soan Syncline formed in the late Pliocene. This ageestimate was based on paleomagnetic evidence that showed that the basal deposits of the syncline belonged to the early Matuyama Chron; and by the observation that the vertical layers of the northern limb of the syncline were truncated, and unconformably overlain by horizontally-bedded fluvial deposits. These had a normal polarity, as well as a volcanic tuff that was dated by K/Ar to 1.6 +/- 0.2 million years ago. This age estimate was consistent with assigning the surrounding horizontal deposits with normal magnetic polarity to the Olduvai Event (10,22). Rendell et al. demonstrated that the artifact-bearing horizon was integral to the Soan Syncline, and not part of a later channel fill. They also showed through very close sampling (280 samples from 71 sampling points with a mean spacing of 1.7 meters) that all the deposits above the artifact-bearing horizon had a reversed polarity, as would be expected if they were deposited in the Matuyama Chron. An additional important, but rarely noticed, point is that these deposits (including the artifact bearing horizon) had all been rotated by 300 degrees during the tilting and folding that had taken place. In contrast, no rotation was observed in the overlying, 1.6 million years old horizontal strata that capped the Soan Formation. This clearly indicates that the rotated deposits were older than 1.6 million years old. This date was

further refined by combining it with the paleomagnetic data from five sections with the Siwalik syncline to 2.1 to 1.9 million years old. Since the minimal age of the normal polarity subchron detected at the base of the artifact-bearing section is 2.01million years ago, it is this date that is favored by the British archaeologists(13,14,23).

Since no such artifact has so far been recovered from the region between East Africa and Pakistan, it is presumed that the development of this tool technology was indeed a local and separate adaptation in both of these localities

Discoveries at the Pabbi Hills: The second discovery was at Pabbi Hills (24,25) The Pabbi Hills lie to the east of the Jhelum River and constitute an area which borders the Pothwar plateau where Riwat is located. The articles found at Pabbi Hills are very simple, and are predominantly flaked pebbles, cortical flakes, disc cores and flakes. The lithic assemblage does not show any handaxe or clever and seems in this sense to be pre-Acheulian. The Pabbi hills have turned out to be very rich in animal fossils of different types, ranging in age between 0.7 and 2 million years ago (25,26). All of the Pabbi hills artifacts are surface finds but paleomagnetic dates for the deposits are available, and one of these deposits, known as SST 12, has been estimated to date from 1.2 to 1.4 million years ago. Based on the age of the faunal fossils recovered from the same area appear to indicate the age of these assemblages between 0.9 and 2.5 million years ago.

“Overall, 607 pieces were found that were considered to be artifacts. Most of these were simple cores (41%) and flakes (58%). The overall density of flaked stone was extremely low. Although flaked stones were found in 21 places, they were found as isolated pieces in 45% of all cases, and in ing from a layer of sand or silt are remote, and even then, it would be hard to disprove that it had been recently trodden in. Four possible explanations were considered, of which two can be quickly dismissed. The first is that the stone was naturally flaked, and resulted from, for example, stones colliding with each other when falling down slope or along gullies. Our own experiments of dropping and throwing similar stones down slopes and onto hard surfaces and of recording stones along modern stream beds showed that this was extremely unlikely in all but 1% of cases. A second possibility is that the flaked items were recent, and the result of, for example, shepherds flaking stones out of boredom, or sharpening an axe by pounding the blade on cobbles, as suggested (but not observed) by Stiles (5). We saw no evidence of any recent tradition of flaking quartzite, and the behavior of bored shepherds that we observed was most unlikely to have resulted in the type of flaked stones that we found.”

View of flaked cobble R001 from Riwat (Dennell and Hailwood**)**

78% of cases, not more than three were found. Al most all (96%) of the lithic assemblage was made of quartzite, and this assemblage is typologically con sistent with the very simple, unstandardized type of assemblages that are elsewhere classed as Oldowan”, wrote Dennel (27).

In the words of the investigators, “establish ing the age of this material proved frustratingly diffi cult, as no pieces were found in secure contexts.

This is inevitably difficult when working in an area of
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of finding an isolated piece of flaked stone protrud

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FIGURE 2. *Flaked quartzite cobble R001* in situ.

The R001 artifact from Riwat; a stone core from which at least seven flakes have been struck off Flaked quartzite cobble R001 *in situ*

“The third possibility is that the quartzite assemblage was deliberately flaked but derived from reworked residues of deposits that formed after the anticline was formed 400,000 years ago. However, if that had been the case, we would have expected to find the type of Acheulean bifaces, prepared cores, or blades that we found elsewhere in northern Pakistan on Middle and Upper Pleistocene exposures. Given the size of the areas surveyed for stone tools and vertebrate fossils (often several times), and the thoroughness of collecting, it is inconceivable that objects as distinctive as Acheulean bifaces or Levallois cores would have been missed. Known later types (such as polished stone axe fragments and flint microcores) account for only a



dozen or so pieces, and retouched items well known from the Middle Paleolithic onwards form only 2.8% of the assemblage."

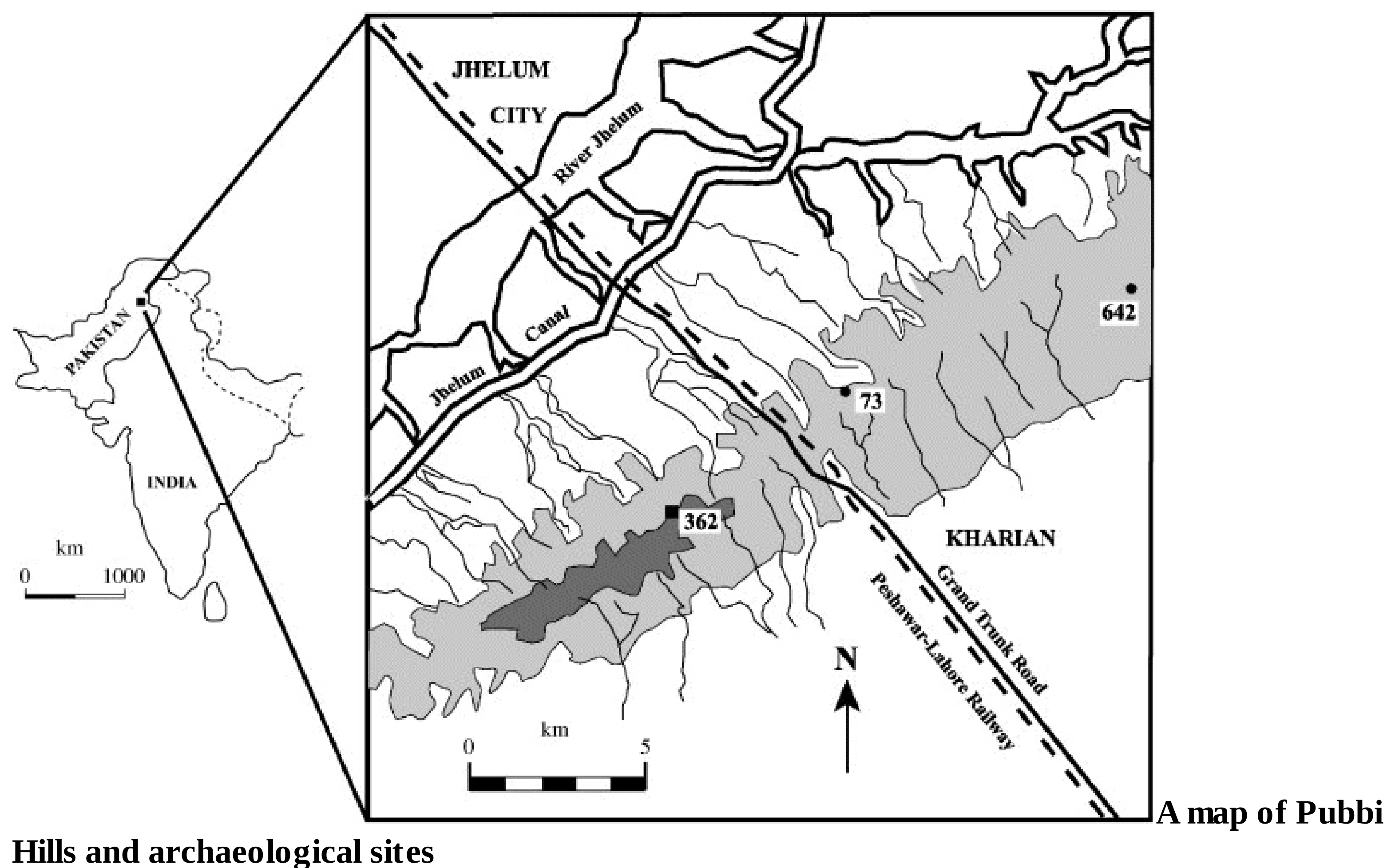
"A second reason that it is unlikely that the quartzite assemblage was derived from post-Siwalik deposits less than 400,000 years old is the high rate of erosion during the summer monsoon. The rate of erosion is such that once exposed, fossils and stone tools are likely to be destroyed by erosion, or washed into gullies and thence out of the Pabbi Hills in a relatively short period, perhaps a century or two. We conducted experiments of placing marked stones on a variety of surfaces and monitoring their movement over a 10-year period. Our conclusions were that most of the stone artifacts on slope surfaces in the Pabbi Hills are very unlikely to be derived from residues of post-Siwalik material from the last 400,000 years" (24).

"The fourth (and in our view, the least unlikely) possibility is that the quartzite flaked stone assemblage originated from the underlying Upper Siwalik strata and is thus (depending on the age of

the exposures on which it was found) between 0.9 and 2.2 million years old. In support of this possibility is the point that there are potentially early types present and these form the most numerous part of the quartzite assemblage (6) Additionally, the low density of material is consistent with what might be expected in a wide flood-plain in which stone was scarce, such as Hata, Ethiopia. Here, the explanation offered was that hominids were operating in areas (as in the Pabbi Hills) where stone was very scarce, in contrast with areas such as Gona, where stone was naturally very abundant”.

“We also made a detailed sketch map of the local area, and recorded the location of all flaked and unflaked stones. Ten years later, we resurveyed the same area. A new stone tool was found, as well as seven other stones that were not seen in 1987. There was also a trickle of fossils down the same gully area, including several fragments of a large animal. There are no obvious redeposited or post-Siwalik layers in the area to account for the stone tool, the pebbles, or the fossils. There is clearly a source of quartzite cobbles within this area, but the excavation data suggest that these could be as isolated pieces dispersed within the sand unit. Although we failed to find artifacts in the excavation, I remain convinced that the quartzite core found in 1987 must have come from the overlying sand unit, and was thus more than 1.9 million years old. A future excavator may have better luck. Full details of this investigation are given by Hurcom” (24).

Salim’s Discoveries at Gurha Shahan*:* Dennell and Rendell’s discoveries at Riwat and Pabbi Hills are quite interesting and their analysis seems to be quite convincing. If there was any doubt, more evidence was provided by Salim (6,28). In 1993, he found tools in the Gurha Shahan area of Rawalpindi in both the Upper Siwalik Conglomerate deposit and the underlying deposit of silts and sands. This underlying deposit represents the Pinjor bed of the Siwalik formations and may date from about 2 million years ago. Incidentally, these excavations were made possible by extensive digging and leveling activities by the highway department excavating Conglomerate and Pinjor silt. The Pinjor deposit retains horizontal bedding and sometimes 20-25 meter sections are present. At its upper layers thin layers of conglomerate are present and within this some flaked artifacts were found imbedded. They were made on quartzite pebbles which



A map of Pubbi Hills and archaeological sites

were of small, e.g. 3.6 cm, size. Animal teeth were also collected. The artifacts included core, flake and waste chips. Some show signs of rolling and abrasion, while others had sharp edges and ridges. Such artifacts were neither discovered nor reported by de Terra and Paterson nor by any other archaeologists including Cambridge Archaeological Mission. For the time being, they can be classified as core-flake assemblage, and future work can determine their identity as a distinct culture or otherwise. Based on the Paleomagnetic data, the Pinjor finds can be placed around 2-2.5 million years ago.

Controversy about Riwat and Pabbi Hills: The discoveries at Riwat and Pabbi Hills became controversial from the day the digs were announced. Similarly, no archaeologist seems to have taken notice of Salim's discoveries at Gurha Shahan. This reaction primarily stemmed from the conceptualization of human origins, evolution, out-ofAfrica migration, and dispersal in Eurasia, to which almost all archaeologists and anthropologists subscribed at the time. First of all, doubts were expressed if the alleged tools were in fact artifacts at all. Secondly, the methodology for dating the Riwat findings was questioned and those of Pabbi Hills outrightly rejected. Objections have been raised on stratigraphy of the strata wherein such tools have been found imbedded, the methods of collecting the artifacts have been criticized, and the smallness of the various assemblages have been pointed to. Since the Riwat and Pabbi discoveries are so radical and since they have become so controversial,

It is common knowledge that the pebble tools are barely distinguishable from any other little rocks and it is never easy to decide whether a lithic assemblage is the result of hominin flaking or not. Dennell et al (8) chose a combination of criteria to distinguish an artifact from a geofact: the numbers of flakes removed; the number of flakes with clearly defined bulbs of percussion; the number of

directions in which flakes were removed; and cortical area as a percentage of the original surface. Using these criteria and a subjective evaluation of the total characteristics of the piece, the 24 fractured lithics from Riwat were rated on a scale from 0 to 5, with 0 denoting a piece indistinguishable from naturally flaked pieces, and 5 convincing for potentially being flaked by hominids. From the 24 pieces, 6 were rated category 4 or 5, 8 category 3, the rest cate

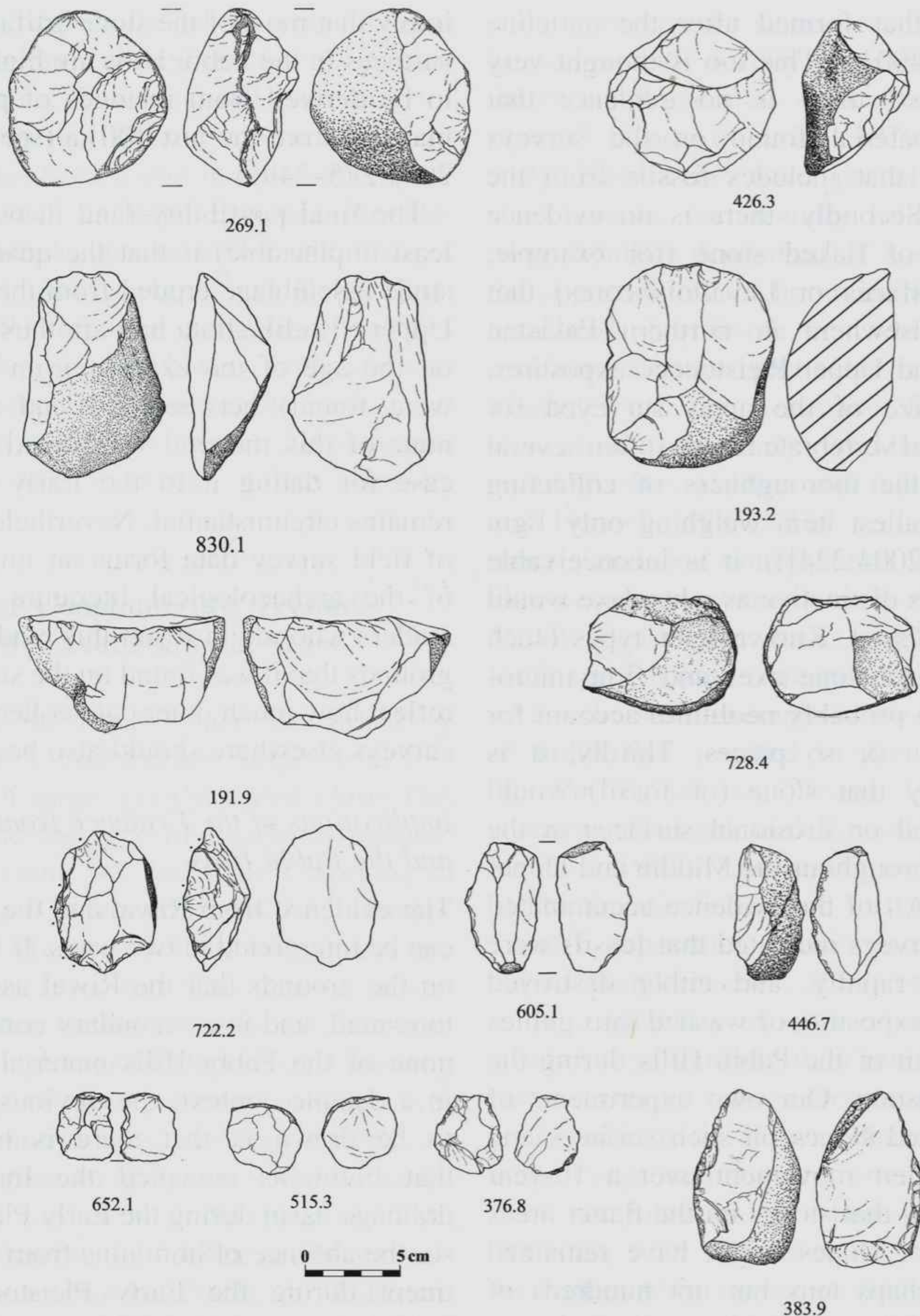


Figure 9. A selection of stone tools from the Pabbi Hills. Source: Hurcombe, 2004

gory 1 or 2. The category 4/5 specimens have only small percentages of cortex, a high number of dorsal scars (up to 8) that are usually well defined, show clear negative bulbs of percussion and ripple scars, and they have been flaked from more than one widely divergent direction. The large 'core tool' ROOI for example had 7 mostly large flakes detached from 5 different directions, while RO 14 had 7

flakes removed from 2 different directions. Given the low incidence of flaked pieces among the clast population of the conglomerate, and the differentiation apparent within the small population of flaked pieces, it seemed inconceivable to the investigators that extensively flaked pieces such as ROO I and RO 14 and the other four category 4/5 pieces are the result of geological flaking processes.

Dennell and Hurcombe, two archeologists faced with the geofact problem at the dig, tried to solve it experimentally. They deliberately dropped quartzite rocks from heights onto hard surfaces. They concluded: "While conceding that had we conducted the experiment with a thousand, ten thousand, or a hundred thousand stones, a few might have fractures, we would nevertheless maintain that the chances of any showing multiple, multidirectional flaking and all with bulbs of percussion are as remote as the proverbial monkey typing

A selection of stone tools from the Pubbi Hills (30)
Shakespeare(29).
The obvious limitations of the Riwat as

we need to dwell a little on the question if the find in question were in fact artifacts and if they indeed date as far back as claimed.

Artificiality of the Finds: The artifacts in question derive from coarse conglomeratic sedi ments which could probably be the result of a high energy fluvial regime and this warrants caution be cause the possibility of geologic flaking does exist. This point has been very well taken by the excava tors, who have argued extensively why these specimens should be interpreted as artifacts and not geofacts (13,14,17). The excavators have thor oughly addressed all key features related to the methodology for establishing the artificiality of the pieces.
semblage is that it is very small; was found in a secondary context even if there is little indication of abrasion and rolling; and is not associated with any other evidence of hominins, such as cut-marked bone or hominin remains. If the evidential threshold is set at, for example, a minimum of 100 unambiguous artifacts, in a primary context, and preferably with associated cutmarked bones, the Riwat assemblage is clearly unacceptable as indicating the presence of hominins. For many researchers, the main reason for not rejecting the small assemblage from Riwat is the opinion of all those who have seen the cast of core ROOl and are quite knowledgeable about early lithic technology that it could not have been flaked naturally.

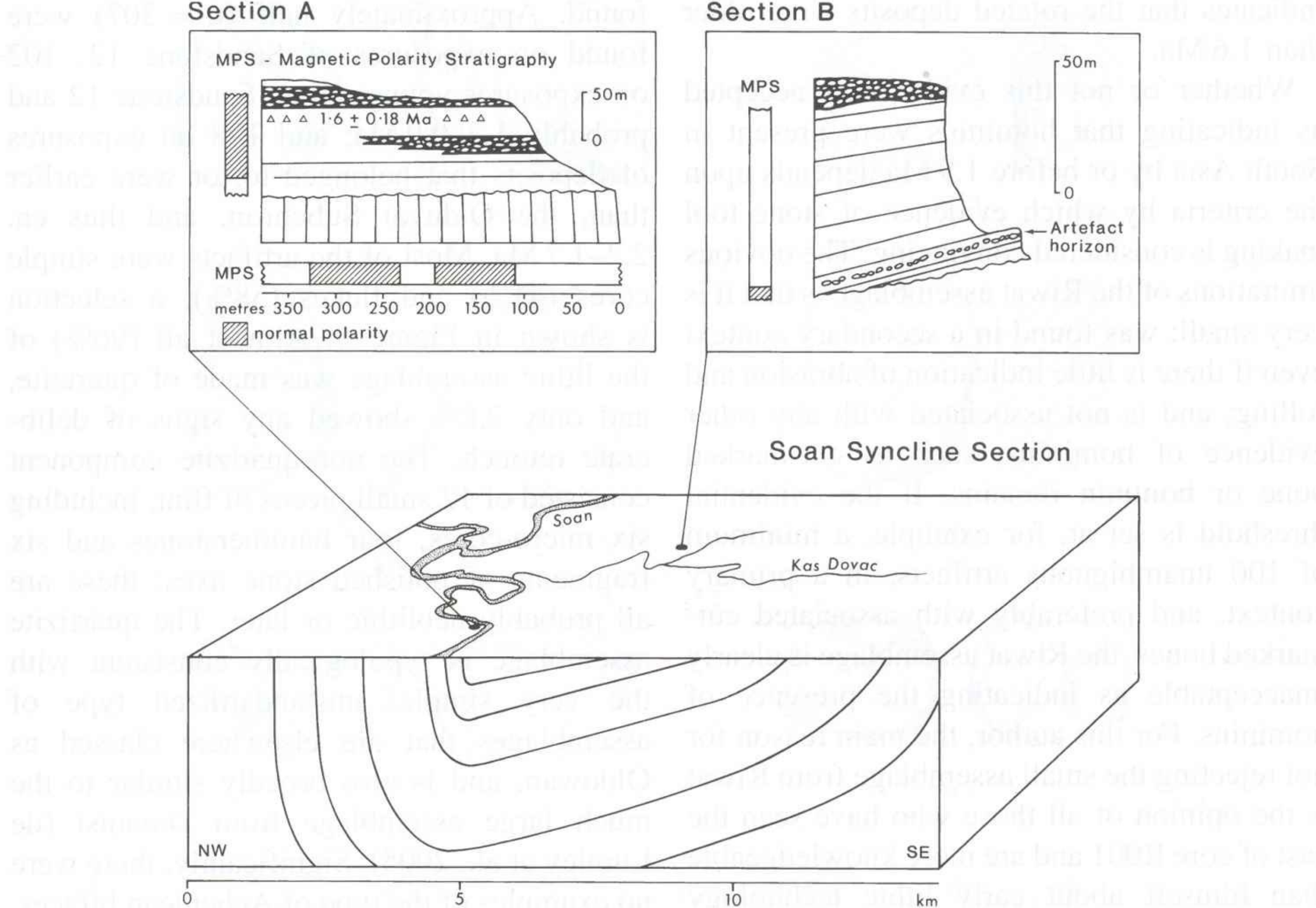


Figure 8. The dating of the artifact-bearing lower conglomerate horizon at Riwat, Soan syncline, Pakistan. The sediments containing the artifact-bearing horizon (section B) slope at 10–15°, but are folded vertically in the part containing section A. Here, they are overlain unconformably by horizontal deposits containing a volcanic ash dated at ca. 1.6 Ma. Source: Dennell et al., 1988: Figure 4

The dating of the artifact-bearing lower conglomerate at Riwat, Soan syncline, Pothwar. The sediments containing the
The dating of the artifact-bearing lower conglomerate at Riwat, Soan syncline, Pothwar. The sediments containing the
artifact-bearing horizon (Section B) slop at 10-15 degrees, but are folded vertically in the part containing Section A., they are
artifact-bearing horizon (Section B) slop at 10-15 degrees, but are folded vertically in the part containing Section A., they
overlain unconformably by horizontal deposits containing a vocanic ash dated 1.6 million years ago. Source: Dennell et al **are overlain unconformably by horizontal deposits containing a vocanic ash dated 1.6 million years ago. Source: Dennell et** been flaked naturally.
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bring forth is the rarity of natural flaking observed in
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showed any signs of flaking (22). Contra Klein (30),

it is therefore wholly inaccurate to say that the
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which this assemblage was found was not known, and its dating was accomplished through a detailed paleomagnetic analysis of the deposit above and below the artifacts by an independent laboratory in 345that capped the artifacts-bearing formation. This England. As described above, the results indicated clearly indicates that the rotated deposits were older

and its dating was accomplished through a detailed
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35°- 40° during the tilting and folding that had taken place. In contrast, no rotation was observed in the overlying horizontal strata (*ca.*1.6 million years ago) than 1.6 million years. That in itself was exciting in 1985, since up to then the oldest artifacts in the subcontinent were those which the members of British Archaeological Mission had already discovered at Dina and Jabalpur (31).

A more precise date was reached by the stratigraphic and tectonic context of the artifactbearing horizon itself, which lies within the folded strata of the Soan syncline (14). The folding of the syncline is inferred to have taken place around 1.9-2.1 Ma. All this can be taken to indicate a minimum age of 1.9 Ma for the artefact bearing horizon (14). The excavators explicitly leave open the possibility that the basal normal polarized episode represents an older subchron than Reunion, which would imply that the possible artefacts could be considerably older than 1.9 million years ago for they believe that a considerable hiatus exists between the artifact bearing sediments and the postSiwalik horizontal ash-bearing sediment sequence on top of it. Indeed, arguments have now been advanced which indicate a possible age up to 2.5 million years ago. The 1.9 million years ago *minimum* age, however, is a more safe and solid date to go with.

The 2 million years date for the chipped pebbles from northern Pakistan is not as outlandish as it seems to be. It is almost in the same range as that of Koobi Fora and Olduvai Bed I in east Africa. In 1994 geochronologists at the Institute of Human Origins redated Homo erectus sites in Java from 1.8 to 1.6 million years ago by using 40Ar/39Ar laserincremented heating of hornblende recovered from fossil-bearing deposits at Mojokerto and Sangiran. A hominin mandible (Homo erectus?) associated with core flake tools from Dmanisi in the Georgian Caucasus is dated to 1.8 million years ago by potassium/argon radiometric methods.

Stratigraphic Argument: The argument of a perceived lack of stratigraphic context has been stated endlessly but the fact is that most of the flake surfaces were embedded in the gritstone at the time of discovery, and thus cannot be perceived as devoid of any stratigraphic reference. The specimens are not heavily rolled: the flake scars on the specimens all appear quite fresh, and although their fluvial sedimentary context points out that they are not in their original context of discard (i.e. they are to some extent transported by natural agents), transport has presumably not been extensive. In addition, tracing the artifact bearing horizon at Riwat over 5 kilometers, pieces regarded as hominid struck were all localized to within 100 meters of each other (16). In this case, the specimens interpreted to be artificial are clearly *not* a small limited selection of 'best' pieces from a very large array of geologically flaked stones. This invokes a dilemma.

A dilemma of interpretation: Comparisons of the Pakistani data with the artifact record from Africa have been based upon the criteria that validity is established when the stone pieces with worked surfaces appear in concentrations, when they are obvious manuports, and when there is clear evidence of hominin association with a faunal record, butchered bones, camp site structures, and so on. Riwat does not provide these kinds of confirmation, and critics note that identification of artifacts also depends upon standardized criteria of technique of manufacture. The materials in question are without benefit of comparative collections of known hominin origins and antiquity whereby correct identification is possible. Furthermore, there is the suggestion that these Pakistani artifacts may be of natural origin and not of hominid manufacture at all.

Responses to these challenges by critics have been prompt, and Dennell (16) observed that the recognition of Oldowan tools by Leakey did not meet all of these criteria and that comparative collections are available from other localities outside of Riwat, at Rohtas, Dina, Jalalpur, the Pabbi hills, and several places in the Soan Valley, all collected since 198I.

The evidence from Riwat and the Pabbi Hills can be interpreted in two ways. If it is rejected on the grounds that the Riwat assemblage is too small, and in a secondary context, or that none of the Pabbi

Hills material. was found in a datable context, the obvious conclusion to be drawn is that there is no evidence that hominins occupied the Indus drainage basin during the Early Pleistocene. If so, the absence of hominins from the subcontinent during the Early Pleistocene might indeed be genuine. (This conclusion also implies that hominins may have entered Java ca. 1.6-1.8 million years ago without crossing South Asia). An alternative possibility is that the evidence from Riwat and the Pabbi Hills is consistent with the observations made earlier on the limited availability of stone in these Upper Siwalik landscapes.

A fundamental issue here is the bias that earliest stone tool manufacturing took place in Africa and that Africa is the continent of hominin origins. Since the colonization of Eurasia was evidenced at the earliest to one million years ago, the dates of 2 million years at Riwat and Pabbi Hills became immediate suspect. Later discoveries at Dminisi, Georgia, and the re-dating of the fossils from Java, however, extended the earliest date of hominin presence in Asia comfortably to ca. 2 million years ago. It is hoped that as these newer dates start to sink in, the acceptance of the Riwat dates will become more and more acceptable. In this case, the scenario of hominin dispersal out of Africa must also experience a corresponding change.

In summary, the obvious limitations of the Riwat evidence are that the stone artifact assemblage is very small; there is no associated faunal material; and they were not found in their primary context. Nevertheless, the flaked pieces are convincing as artifacts; they were found in a secure geological context, in a layer that is part of the Soan Syncline, and they are therefore Late Pliocene in age. The evidence is also consistent with what would be expected of hominins in a landscape where stone was scarce: the conglomerate layer in which the artifacts were found was the only one with flakable stone in the entire 70-m section, and thus presented one of these rare opportunities when tools could have been made.

Implications of the Evidence from Riwat and the Pabbi Hills: If the long chronology for hominin occupations of Eurasia is correct, there should be an expectation that Mode I assemblages of Late Pliocene or Early Pleistocene age would be recovered in South Asia. Indeed, one might expect that the Plio-Pleistocene environment of the Upper Siwaliks would be particularly attractive, with its high biomass in grassland and savanna settings (51). Yet, the evidence for early Mode I occupations of the subcontinent is meager and controversial. The Riwat locality in the Soan Valley represents one of the best potential cases for a Late Pliocene presence of hominins in the subcontinent. It contains a small number of flaked pieces that are from a boulder conglomerate context dating to ca. 1.9 million years ago or more (62,13) . In a second important locality in the Upper Siwaliks, archeological investigations in the Pabbi Hills has yielded stone artifacts on erosional surfaces of fossiliferous deposits (8). Overall, 607 pieces of flaked stone were found that were considered to be made by hominid, some of them belonged to, or were earlier than, the Olduvai Subchron, *ca*. 1.7-2.2 million years ago.

These finds, if broadly accepted, have several implications for our understanding of early human developments. The first is that they are considerably older than any well-provenanced find of either hominid fossils or artifacts in Eurasia. As we have seen earlier in this book, there are no archaeological finds or fossil hominid remains from Eurasia that are definitely more than one million years and possibly more than 1.6 million years old. These finds effectively double the length of the archaeological record outside Africa and place it in the same temporal horizon as that of the Rift Valley in East Africa. This surely needs a fundamental adjustment in our understanding of the

origins and spread of hominins. On the basis of their results, Dennell and Rendell argued that current thinking on early hominid development may need substantial reappraisal and that the following should be at least considered.

1 . *Hom*o *habilis* was distributed as far east as Pakistan; or
2. Homo *erectus* is an Asian lineage at least as old as Homo *habilis*; or
3. Another, as yet unrecognized, tool-maker may be implicated.

"One matter that seems clear is that early tool-making has an Asian as well as African dimension", they concluded (13).

These discoveries broadly support a thesis that hominids were settled in South Asia by late Pliocene, in the time period earlier than the Pliocene-Pleistocene boundary and the early hominids who colonized northern Pakistan were toolmakers. This early dispersal of hominids in Asia seems are no doubt probable because of the development of vast stretches of grasslands (Dennell's "Savannistan"), stretching from central Africa all the way to the Thar and the Great Desert of China. The argument goes that if early hominids and their precursors could spread up to central Africa prior to one million years ago, then why could not they spread in a similar environment of Eurasia up to Pothwar. Section III covers these arguments in some detail. The conclusions reached by Dennell and associates are provocative for they propose that the antiquity of man in "northern India" equaled that of Africa.

It is strange that a comparable work was undertaken in Pakistan 50 years earlier but their conclusions remain unchallenged. Referring to Helmut de Terra, T.T. Paterson, and Teilhard de Chardin half a century before in 1930s, Dennell and Rendell wrote: "We would contest almost all their (de Terra et al) geological and archaeological claims. However, one of the ironies in this story is that they may have been right, but for the wrong reasons, for what we report here are: artifacts, in a secure geological context, that we believe are of comparable antiquity to the oldest well-provenanced artifacts from Africa.", as postscript (13). This may also serve as a suitable post-script for this chapter as well.

This area of enquiry is still open for research and speculation. Until the bones of the manufacturers of these stone tools are found it is not possible to know if they were members of a taxon already known from hominid fossils in Asia, Africa, or Europe or a hominid not yet accounted for in the fossil record.

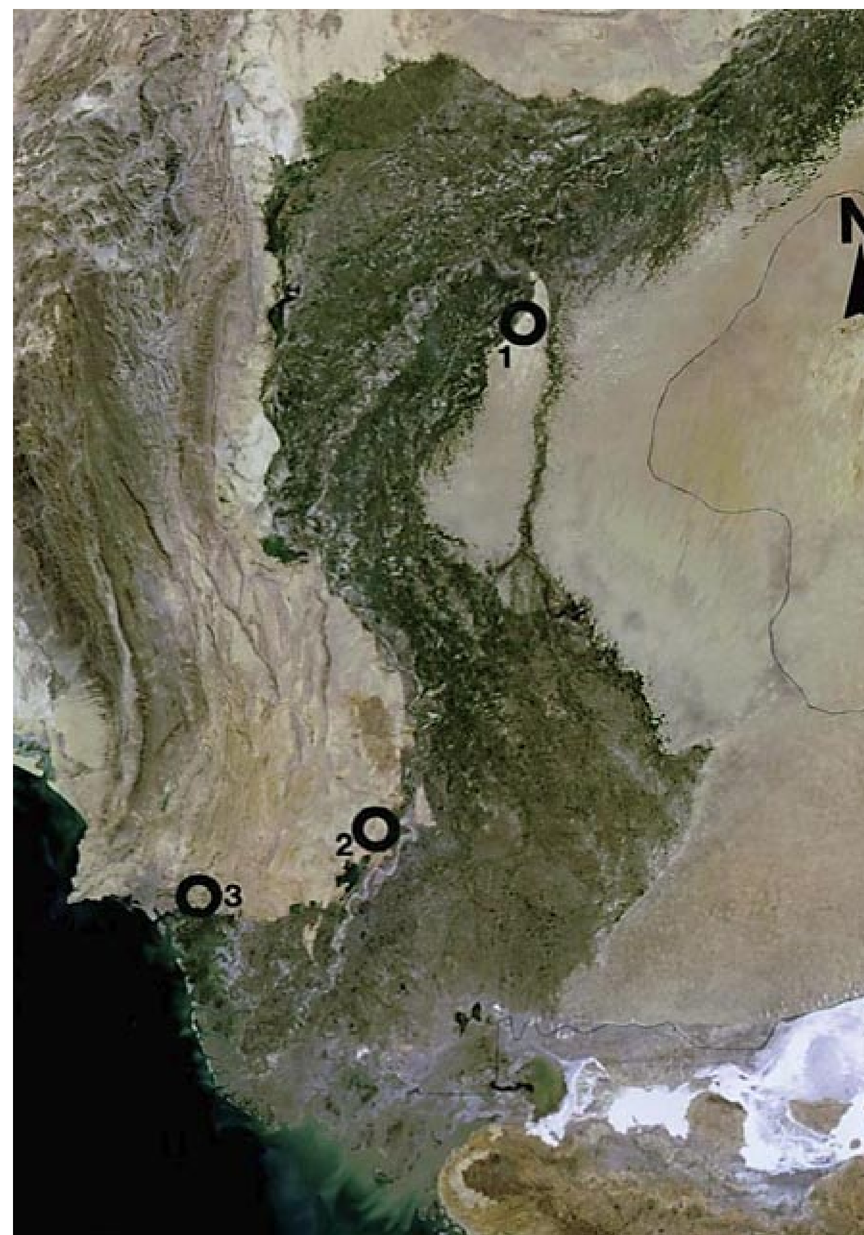
Summary: It is now time to reflect on what we have seen in the lithic record of South Asia generally and try to figure out the trajectory that humans have followed in Pakistan in their evolutionary journey and cultural change during their earliest detectable presence in Eurasia. Stone artifacts are our primary evidence in this quest but, as is evident from the discussion in the foregoing chapters in this section, they do not tell us the whole story, they need to be examined under the light of genetic research and relate to fossil evidence in the region. More importantly, we need to exercise of imagination and employ quite a bit of conjecture for making sense of the evidence in the framework of theoretical models of one kind or the other.

Humans did not evolve in Pakistan, and in South Asia generally, in isolation; their journey was most likely in unison with population groups that inhabited the neighboring areas in the Far East as well as in the Far West. Early humans in this part of the world were an integral part of greater humanity that populated the globe. We are thus forced to look at human evolution and cultural change in South Asia in context with a much larger picture. Given the remoteness of time, an immensely long cultural period involved, the vast spans of geographic distances, a high level of environmental diversity, and the vast scope of the subject matter, it will be pretentious to even attempt an overview of the course of this journey. Nevertheless, we can review the archaeological record of this region if we keep our attention focused on a very few aspects of cultural change and try to look at human evolution from

outside in. Approaches may differ from author to author and the focus may vary. Here we follow the summation by Petraglia and Allchin, published in their *The Evolution and History of Human Populations in South Asia,* under the title *Human evolution and cultural change in the Indian Subcontinent* (64) . As is evident from the foregoing pages, one of the most intriguing questions in paleoanthropology today concerns the timing of the earliest exit of hominins out of Africa. Exciting fossil discoveries in the Transcaucus date the earliest dispersal to ca.
1.8 million years ago. The Dmanisi locality indicates that the earliest colonization of Eurasia was by relatively small-brained hominins that manufactured tools reminiscent of those found in the Oldowan of Africa. Archaeological evidence in the Levant indicates the presence of hominins by 1.4 million years ago. While fossil localities in Indonesia indicate that Homo *erectus* reached Java by 1.8 million years ago, the earliest hominid occupation of the Indian subcontinent is poorly known and controversial. One of the best contenders for an early occupation of the subcontinent comes from the Upper Siwaliks of Pakistan (24). The localities in the Soan Valley and Pabbi Hills consist of unstandardized cores and flakes, indicating typological and temporal affinity with the Oldowan. Although the findings of the upper Siwaliks research has not been conducted without criticism (30,65,66), the research is key to our understanding of the spread of hominins in the Late Pliocene and Early Pleistocene. Independent support for Dennell's prolonged research is provided by Turner and O'Regan (67), who argue that the most probable period of mammalian movements out of Africa are in the later Pliocene, thus making a hominid dispersal in this time period distinctly possible. Although Mode 1 tools are often described as ‘simple’ industries, their role in hominin adaptations was crucial to their survival. The development of such technologies in Africa by 2.5 million years ago ensured access to a greater range of vital resources, such as meat and marrow. If hominins were tool-dependent creatures, as is usually assumed by archaeologists, then the availability of usable stone on the landscape is of critical importance. In contemplating the presence of tooldependent hominins in the subcontinent, Dennel (68) has highlighted geographic differences in stone availability between the Siwalik Hills and their drainage system. Dennell plausibly reasons that the wide floodplains of the Indus and Ganga-Jamuna belt, with scarce workable stone, presented serious challenges to hominin adaptation, thereby accounting for the lack of archaeological sites. In this view, the conditions in the large river systems of the region were not conducive to hominin settlement until deposition of boulder conglomerates in the early Middle Pleistocene.
In contrast with the rather scant evidence for Mode 1 sites, Acheulean localities are relatively abundant and found in many different geographic areas of the subcontinent. South Asia represents the eastern-most location for the expansion of Acheulean hominins, yet little is known about the date of their initial entry into the subcontinent. The first application of the ESR method on Acheulean assemblages yielded preliminary dates of 1.2 million years ago at the Isampur Quarry. Otherwise, chronometric dates in Pakistan place the Acheulean to shortly before 780,000 years ago (69). All other Acheulean sites on the subcontinent indicate a short chronology, samples dating to between ca. 350 and 200,000 years ago (66), 500,000 years ago at the maximum (70,71,72,73,74).
Although archaeological surveys have been performed in many parts of the subcontinent, successfully identifying Acheulean sites, too few excavations have been performed which aim to recover environmental and behavioral information. A recent exception has been the high-quality excavations at Attirampakkam (India), which have documented stratified paleolithic deposits extending to a depth of 9 m (75). The dating of these strata has been, however, controversial; Pappu claiming an earliest date of 1.5 million years ago while other archaeologists vehemently opposing it. A wide geographic reading of the fossil evidence indicates that Mode I hominins of the subcontinent would have been part of the initial Out of Africa expansions, evidenced by early Asian Homo *erectus* populations (assuming the legitimacy of a Mode I in Pothwar and a dispersal link between South and

Eastern Asia). Hypotheses have been put forward that suggest that Homo *erectus* speciated in Eurasia, though the lack of Pliocene fossil evidence precludes further consideration. Early dates of 1.2 million and 780,000 years ago for Isampur (India) and the 1.9 to 2.1 million years ago for Upper Siwaliks in Pakistan, although to some degree all controversial, may indicate expansions of later populations of Homo *erectus* carrying an Acheulean technology. On the other hand, if a short chronology for the subcontinent is favored, i.e., less than 500,000 years ago, Homo *heidelbergensis* populations may be responsible for the spread and manufacture of Acheulean technologies. Lending evidence for this hypothesis, the Narmada fossil is associated with late Acheulean technology and mammalian fossils dating to more than 236,000 years ago (76,77).

VI.3. The Early Stone Age of Pakistan



In the last chapter we reviewed the evidence for the pebble tools similar to those found in the Great Rift Valley of East Africa and belonging to a comparable timeline of about two million years ago. We examined the artificiality of these finds and attempted to correlate them with similar artifacts from

elsewhere. In this chapter we are concerned with the lithic evidence after this remote period of human evolution - a time period that spans between 1,000,000 and 300,000 years ago. This time period is generally considered the Lower Paleolithic in most parts of Eurasia. We find a great array of stone tools in several pockets of Pakistan. The wealth of evidence for the Lower Paleolithic is, however, not matched by finds of the artifact manufacturers themselves. Despite the large number of archaeological surveys over the Greater Indus Valley, no human fossils of early humans have been discovered. The same situation prevails in neighboring India and Afghanistan. The Narmada calvarium, described elsewhere in this book, represents the only hominin find to date. The fossil has been variably classified as *H. erectus*, archaic *H. sapiens* and *H. Heidelbergenis* and dated to somewhat later than 300,000 years ago.

This dearth of Pleistocene hominin fossils in the subcontinent has been sometimes viewed as a

product of survey intensity, leading some archaeologists to remark that concerted efforts should be made to find hominin fossils in probable locations. Indeed, the subcontinent, especially the Pothwar Plateau, does contain Pleistocene mammalian faunas in river valleys in Acheulean contexts, giving paleoanthropologists hope that hominin fossils may be some day discovered. Dennell and coworkers, under the umbrella of the British Archaeological Mission to Pakistan collected thousands of faunal remains in Pabbi Hills in 1980s but none that of any hominin. The researchers pointed to the obvious bias in favor of the recovery of animals that are larger than humans, indicating that identifiable hominin fossils would be rare finds, if it ever happened.

The Early Stone Age or the Lower Paleolithic in Pakistan is primarily associated with the Pothwar Plateau, especially the Soan Valley, although there are some indications of early man's presence in Sindh and the south-eastern foothills of Baluchistan also. Some evidence of early toolmaking activity has also been reported in the MurriBugti country but the extent, or even the veracity, of it is not confirmed. The artifacts of the Early Stone Age, that is, those generally belonging to the Lower Paleolithic, are not recorded prior to 300,000 years in South Asia but Pakistan seems to an exception. Here, as described in the followings, at least two sites, both in Pothwar, have yielded stone tools, which have been credibly dated much prior to this date. Additionally, There is the question of the artifacts that are designated as Soan Industry; some of these tools comfortably fall into the timeframe of the Early Stone Age. None of the findings in Sindh and elsewhere has been dated but their typology and form make them realistic candidates to be included in the Lower Paleolithic artifacts, of course without assigning to them any firm dates.

Broadly speaking, two lithic traditions or technological complexes are recognizable in the Early Stone Age of Pakistan: a biface core-tool tradition generally similar in form and technique to the Acheulean of Europe and Africa, and a tradition which is rather specific to the Soan Valley in the Pothwar region and bears some vague resemblance to that of China, parts of central Asia, and the Far East. This particular tool tradition has been named the Soan Industry. These two technological elements, i.e., the Acheulean and the Soanian tool traditions, coupled with the choice of particular raw materials for making stone tools, impart the Early Stone Age of Pakistan a distinct character of its own and render it in many respects quite different from those of the neighborhood, that is, Iran and India.

The Lower Paleolithic artifacts in the Pothwar Plateau certainly provides us with a window to look into the transition from man's first use of deliberately fragmented pieces of stone to the manufacture of fully conceived implements whose final form is regularly patterned and whose shape in no way suggested by the shape or exterior texture of the stone from which they were made. This is certainly a significant step in conceptualization of cultural evolution of our ancestors and foreshadows the more complex innovations of the Middle and Upper Paleolithic which were to come. It occurs, however, in the context of the very slow and gradual change that characterizes the cultural history of this period all over the Old World. Pakistan was no exception.

The stone artifacts of the Early Stone Age in Pakistan have all been collected from open air sites, either on the surface of various geological formations or within them. A number of sites of this nature are known and are spread over large distances of space and time. Much of the data is from less-than-adequate surveys undertaken in the past in connection these artifacts transported from their place of manufacture or use and most of them are severely abraded and rolled. There are, however, some Lower Paleolithic tools, especially in Sindh, which are found where their user probably left

them lying.

It was long thought possible to divide Pakistan's Early Stone Age into northern and southern cultural spheres. In the north the best explored regions are those of the Soan and Haro Rivers. The climatic phases in the regions of these rivers are not yet well established, but there are indications that the earliest tools found there correspond to the early Pleistocene, the environment of which we know very little. These tools are mostly large, heavy flakes, constituting the the Soan Industry, for which an internal evolution over time has been recognized on the basis of both typology and stratigraphy.

In the South, evidence for the Early Stone Age of Pakistan comes from the Lower Indus Valley, covering the top of the limestone outcrops protruding out of the vast alluvial plains of Sindh and Lasbela. In this respect, the Mile 101 area, near Hyderabad, Sindh, is particularly important. Here researchers like Bridget Allchin, have found clear evidence for the presence of early humans who were making chipped stone tools from chert nodules. Like Pothwar in the North, the available evidence comes from surface scatter. These surface spreads include material of Middle and Upper Paleolithic types, mixed with some occasional artifacts from Lower Paleolithic.

Despite discovery of numerous Lower Paleolithic sites in Pakistan, only a minimal understanding of adaptive patterns exists. The distribution of known sites suggest that early humans congregated along shallow stream banks and lake margins during moist periods to exploit animals and plants. The Early Paleolithic sites in Pothwar as well as those in southern Sindh represent this scenario.

Since there is no clear demarcation between the Early Stone Age and the later Middle Stone Age or between the Early Stone Age and the earlier Pre-Soan Industries, and since the stone artifacts of one stage have often been found mixed with those of the next, it is almost impossible to know if the given artifacts belong to the Early Stone Age or the time preceding or following it. This means that the typology of a stone artifact does not with geological

represent the research. Most of materials naturally give us a definite idea as to its age. One needs to connect the given archaeological find with a secure geological formation. Such connections are unfortunately rare. Nevertheless, archaeologists and anthropologists ar*e* continually attempting to extract precious information from the available evidence, however slim and however tentative. This information they then relate to the activities of the long extinct hominins who populated this piece of land a long time ago. This is a detective work in its scope, often yielding results that are only tentative and quite often speculative.

A second major problem that has afflicted Lower Paleolithic studies in Pakistan, as elsewhere, has been the difficulty of establishing an absolute chronology for artifacts and sites. Until we are fully aware of the complexity of the Pleistocene record and develop techniques to link our archeological evidence to an absolute time scale we will be unable to make more than the most general hypotheses concerning the dispersal of hominins, colonization of various regions and frequent abandonment and re-colonization of different areas. Such dates and their mutual correlations are now becoming available, although grudgingly and hesitantly. Similar efforts in Europe and elsewhere are also helping to draw such chronological or sequential relationships and the Early Stone Age of Pakistan is gradually coming in focus.

We would like to review these developments under two major areas of archaeological intest:
1) The Sub-Himalayan Region, especially the Soan

Valley.
2) The Lower Indus Valley and and Coastal region.
THE SUB-HIMALAYAN REGION

The Early Soan Industry: During his geological work in Pothwar, Helmut de Terra recognized some pebble tools in his assemblage, which, according to him, were typologically different from the commonly known tools at the time, i.e. the Acheulean handaxes. They did not fit in any other category of tools either. These types of tools, which were made on round pebbles, were already known as "Chopper-Chopping Tools Complex" from the Greater Rift aVlley area of East Africa; de Terra, therefore, described his new-found artifacts also as Choppers-Chopping Tools but to distinguish them from the generic category named them *Soan Industry* after the river that flows through this region.

The Choppers were the pebbles that are flaked from one side, and the chopping tools were those which were flaked from both sides. On both types of these tools, flaking is usually confined to one end of the pebble only, whereas the other half retains round cortex area to be conveniently held in hand. Associated with these pebble tools are cores of various types with deep flake scars, from which flakes of different types were detached. Like Oldowan in East Africa, Choppers and Chopping Tools in northern Pakistan represent an early stage of tool-making technology but certainly later than the pebble tools of extreme simplicity, described in the last chapter. These 'pre-Soan' tools can be taken as ancestral to the Soan.

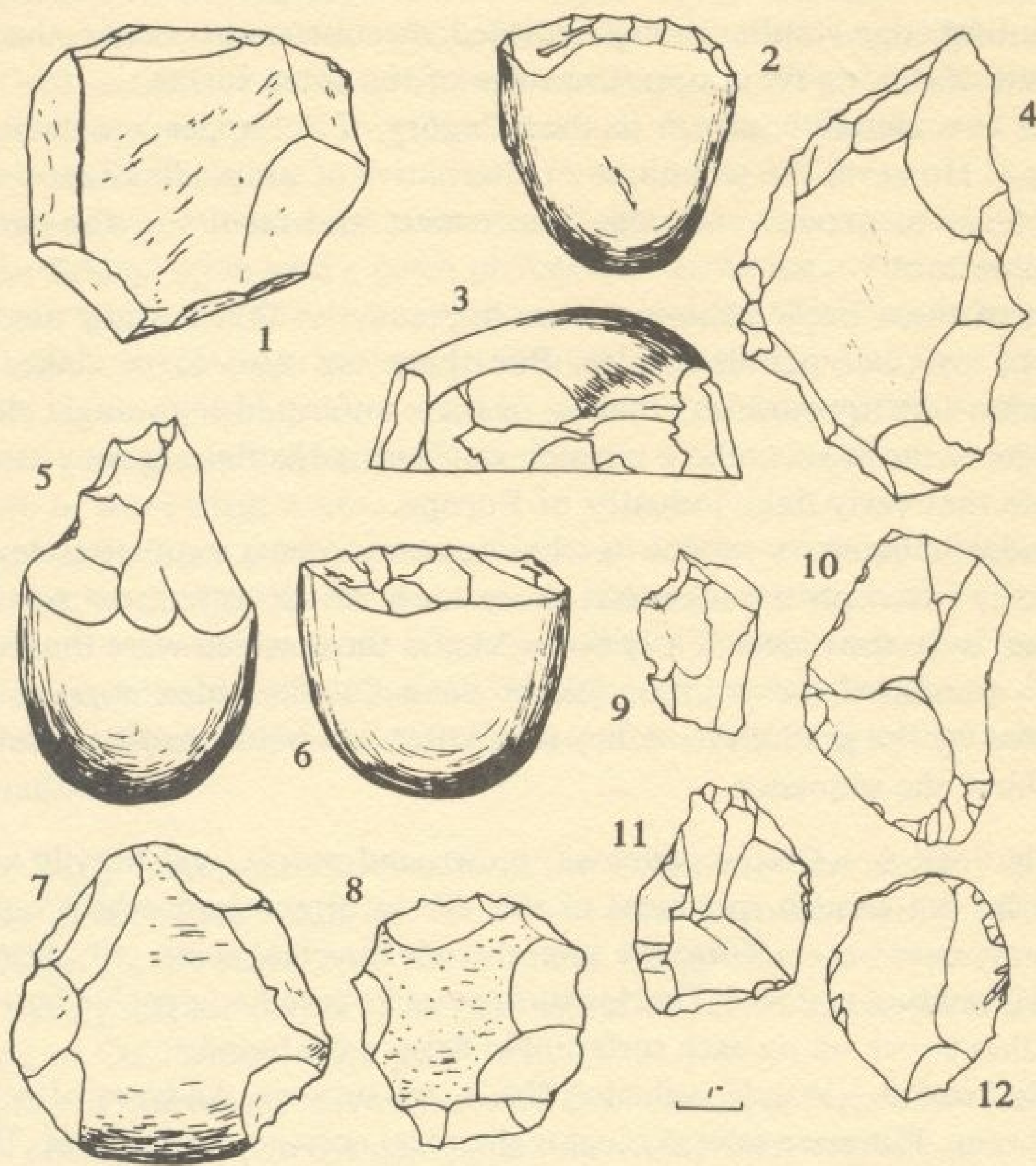


FIG. 6 *Early Soan tool types* (after de Terra and Paterson, 1939).
1—"*Pre-Soan*" *flake from Boulder Conglomerate at Kallar*
2, 3, 4—*Early Soan pebble tools—flat-based type*
5, 6—*Early Soan pebble tools—rounded type*
7, 8—*Early Soan discoidal cores*
9–12—*Early Soan flakes*

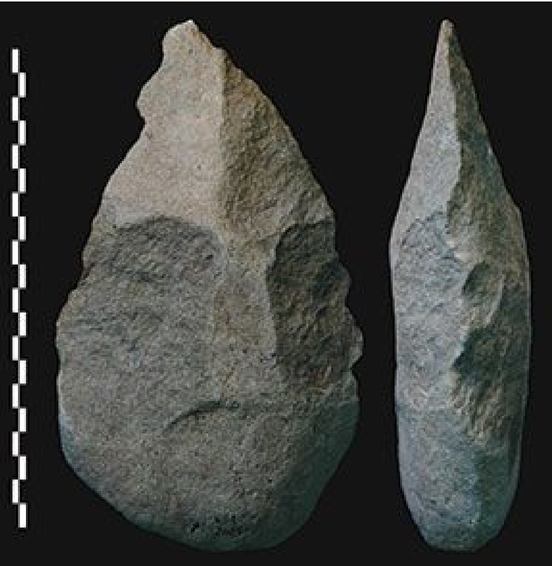
Typical early Paleolithic tools from Soan Valley; a) handaxes of Acheulean tradition, b) Pebble tools from Soan tradition (after de Terra)

Surface spreads of these artifacts are common throughout the Pothwar Plateau although most of the finds come from the Soan Valley, covering the summits and flanks of eroded Siwalik terrains. Some examples are those reported by de Terra and Paterson (32), Dennell (8,33,34,35), Fairservis (36), Sankalia (37) and Salim (6). This industry gradually became transformed over the years and passed through a series of advances in flaking techniques that led to the Late Soan industry and Developed Soan Industry. Chronologically, only the very early phases of the Soan Industry is supposed to belong to the Early Stone Age of Pakistan.

Early Soan Industry consists of a large number of tools made on split pebbles (or pebble halves) and comparatively small number of flakes. The material comprises varieties of fine-grained quartzite as well as smooth gr.eenish grey Punjab trap. Among these tools, there are pebble tools, scrapers, cores, and flakes and a few protohandaxes (37) but the pebble tools predominate. The ready availability of raw material, the apparent simplicity of form, and the characteristic method of flaking them makes the Early Soan primarily a pebble-tool industry at par with that of the Developed Oldowan Industry some 1.5 million years ago in Africa. There are, of course, some flake-based tools included in the Early Soan tool industry under discussion. These flakes retain the cortex on the upper surface and there is no retouch. The flakes of quartzite chopped only on one side with large bulbs of percussion have been found at several locations in the Pothwar Plateau and so far such flakes have not been found anywhere else in Pakistan or the continental India. The pebble chopping tools recall Africa and the so-called pre-Soan artifacts discussed in the last chapter.

Acheulian tools: Acheulian was the dominant technology for the vast majority of human history starting more than one million years ago. Although it developed in Africa, the industry is named after the type site of Saint-Acheul in France, where some of the first examples were identified in the 19th century. While the Soan artifacts are generally chipped randomly on one face, these advanced tools, that is, the Acheulian, were shaped more symmetrically on both sides (producing a "biface") and also had chiseled edges that would have helped their makers butcher large animals and other scavenged game left behind by other predators or even have allowed them to hunt such prey themselves.

Radiometric dating in Africa and Eurasia shows this particular indus try lasting from around 1.8 million years to about 100,000 years ago. The earliest tools generally ac cepted as examples of this type come from the region west of Lake Turkana in Kenya (see the image be low). Early Acheulean stone tools occur across most of Africa, except in rainforest regions. These tools have also been found throughout Eurasia, in more recent deposits south of the regions of Pleistocene gla ciation. In Asia, they are known from Turkey, Iran, Pakistan, India, and south east Asia. In Europe, they reached as far north as the Danube and, further west, are known from France, as



Early humans were using stone hand axes as far back as 1.8 million years ago.

This sample os from Kenya
(National Center of Scientific Research, France**)**

well as the lower Rhine valley and southern Britain. Further north, glaciers prevented human occupation. Such a technology, howeverr, did not exist in China and the area east of India.

Acheulean technology is best characterized by its distinctive stone handaxes. These tools are pear shaped, teardrop shaped, or rounded in outline, usually 12–20 cm long and flaked over at least part of the surface of each side (bifacial). There is considerable variation in size and quality of workmanship. They were manufactured from a flint core. By hitting all sides of the core with a hammer stone, the toolmaker knocked off flakes until a pear shaped tool was formed with a pointed end and a sharp cutting edge. Commonly described and photographed handaxes are from Europe; some of these are artifacts of exceeding beauty. Such symmetrical objects are rather rare in the Early Paleoliothic of Pakistan, most of them are merely functional, to say the least.

In Pothwar, the Acheulian handaxes of the Early Stone Age do not always conform to this typical configuration but the general form with sharp extensive use of the soft-hammer technique, and the knowledge of the Levallois and discoid-core techniques. The Late Acheulian assemblages are generally smaller, thinner, and more refined, with a significant increase in the degree of retouching and controlled bifacial thinning/flaking.

During 1970s large surfaces of Boulder Conglomerate in Pothwar were excavated and exposed by highway department bulldozers and these activities laid bare a large number of Paleolithic arti

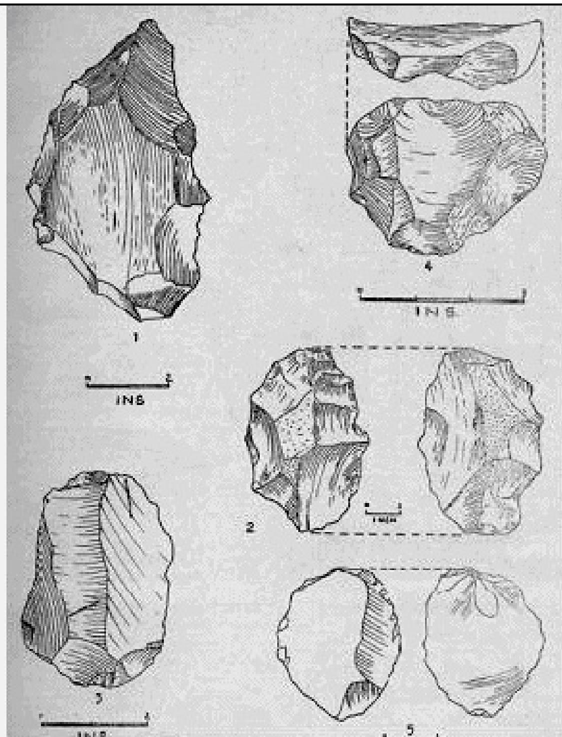


facts. These have been analyzed and reported by Salim (6). What de Terra and Paterson reported in 1930s were still found within this Conglomerate; flakes, pebbles, large rolled flakes with prominent bulbs, developed cores of percussion and, along with them, typical Acheulean tools such as handaxes, cleavers, scrapers, notched and denticulated tools were also present at one site (6). The number of recovered tools was truly large: 98 pieces were gathered from Site PS-7 alone (6). These included hanadaxes-cleavers and other flake tools. These artifacts were tentatively dated around 500,000 to

edge all around and a pint on one side is the same. The handaxes picked up in the Lower Indus Valley, however, contain some examples which are su perbly made. These artifacts probably belong to later stages of the Stone Age, probably to the late Middle Stone Age. It must be kept in mind that, by and large, Acheulian tools from the Early Stone Age of Pakistan, whether handaxes or cleavers or scrapers, are to a large extant ill-defined imple ments and have only a faint resemblance to the 'typical' Acheulian tools found in the Middle Stone Age in Pakistan and elsewhere.

Acheulean handaxes were multi-purpose tools used in a variety of tasks. Studies of surface wear patterns reveal the uses of the handaxe in cluded the butchering and skinning of game, dig ging in soil, and cutting wood or other plant materi als. Additionally, Acheulean tools are sometimes found with animal bones that show signs of having been butchered. The handaxe was not the only tar get of the Acheulean manufacturing process. Like the Oldowan, the flakes struck off the stone core in creating the handaxe were also used as scrapers and cutting instruments. Later Acheulean industry, employed the Levallois technique that yielded flakes of preplanned shape and size, greatly improved the efficiency and utility of flakes as tools.

Early Acheulian bifaces in Pathway are of ten asymmetrical, large with thick butts or mid sections and possess large and bold flake scars (albeit irregular), indicative of hard-hammer percus sion. In contrast, Late Acheulian assemblages are represented the high ratio of cleavers to hand axes, the very high ratio of flake tools like scrapers, the



Early Soan flakes and core from Pothwar (Sankalia**)**

800,000 years ago. In 1980s, Dennell and Rendell reported handaxes and other artifacts from eastern Pothwar; one near Dina and the other near Jalalpur. Both were *in situ* discoveries and, based upon paleomagnetic dating, were dated around 500,000 to 700,000 years ago, essentially confirming the tentative dates arrived at by Salim for his collection.

Because current dating of the Acheulian sites in Pakistan is limited (only two confirmed dates are presently available), relative ages of Acheulean artifacts are often proposed on typological grounds. Two groups are recognized. The first and probably older one consists of handaxes, choppers and polyhedrons, a low proportion of crudely made cleavers and of flake tools, the predominant use of the stone hammer technique, and the absence of the Levallois technique. Handaxes and cleavers are usually thick, often retain much of their cortex, and have sinous edges. The second and probably younger one is characterized by the low proportion of bifaces, the high ratio of cleavers to handaxes, the very high proportion of flake tools like scrapers, the extensive use of the soft hammer technique, and the knowledge of the Levallois and discoid tech

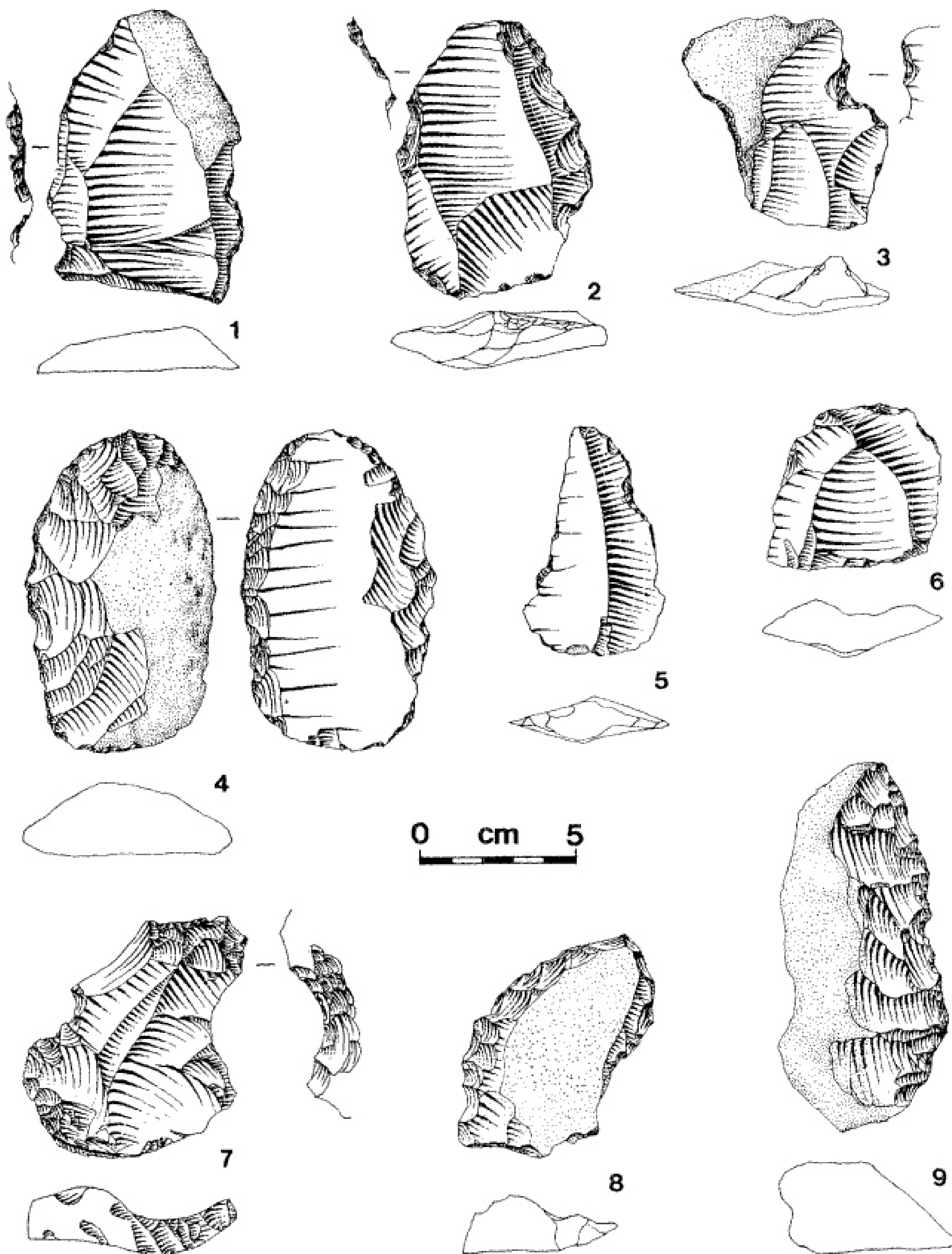


Figure 8 1, 2, 6: flint artefacts from Unnar Hill; 3, 5: Bridge Site, 4, 9: Unnar; 7: Red Hill; 8: Mutton Jugoth.

Flint artifacts from Unnar Hill (1,26); Bridge Site (3,5); Unnar (4,9); Red Hill (7); Mutton Jugoth (8). (from Biagi**)**

nique. Because soft hammers were used more often, artifacts were usually thinner, and edges less sinuous.

The above classification is, however, purely conjectural as this scheme of typological dating rests heavily upon untested hypothesis that artifact thinning and refinement equate to age. Its validity clearly depends upon stratigraphic criteria and requires independent demonstration that a crude Acheulean assemblage is in indeed earlier than a refined one. Such a stratigraphic reference is available from different erosional terraces in the Soan Valley, as worked out by de Terra and Paterson (32), and from the paleomagnetic surveys on various geological formations in the Pothwar Plateau and the Salt Range but not to the satisfaction of all.

Unlike the Earliest Pebble tools and the Soanian artifacts, which are confined to the Pothwar Plateau, the Acheulian tools are common all over Pakistan and continental India. Acheulian sites occur in alluvial, coastal, hill slope, surface, and rock shelter localities. Within these geomorphic settings, undisturbed sites are rare. However, good primary sites have been found in Pothwar and Sindh. Their frequency in the North is, however, less than that in the South. Almost the same situation is at hand in India where Acheulean tradition is more common in the South and less in the North and the Northeast. In Pathway, some of the tools of Acheulean tradition have been found mixed with those of the Soanian tradition but most of the examples are where only Acheulean or Soanian tools alone have been located. This dichotomy has been discussed elsewhere in some detail.

Although handaxes of Early Stone Age have been found at many sites in Pakistan and India, they were all surface finds and therefore not amenable to be dated in terms of absolute chronology. Rendell and Dennel (9,38) were, however, been able to find such artifacts in situ. These were found at Dina and Jalapur and are dated to postBruhnes time (<800,000 yerars ago) and pre-tilting of the sediments and so estimated to date to 500,000-700,000 years ago (9,21,39; also see the last Chapter). Fourteen additional artifacts, including two handaxes, were also found near Jalalpur in a gritstone/conglomerate lense, possibly of the same approximate age (63). At Dina, a handaxe was found within and underlying a quartzite conglomerate, and at Jalalpur fourteen artifacts, including two handaxes, were recovered from a gritstone/ conglomerate lens (9,36). The investigators correlated the artifact-bearing horizons with deposits that were previously dated to 700,000 to 400,000 years ago through palaeomagnetism by R.G.H. Raynolds and others (63). Interestingly, the investigators did not encounter Soanian artefacts as per De Terra and Paterson's description, and as such do not regard it as an independent lithic tradition (22).

Being the earliest datable finds in South Asian context, the discoveries at Dina and Jalalpur are important in defining and characterizing the Lower Paleolithic or the Early Stone Age of South Asia. These are still the earliest definite indications of the Acheulian in South Asia, apart from the recent ESR date of 1.27 million years ago from Isampur, India, which are as yet controversial.

The above description of the artifactual scatter in the Pothwar region gives an impression that the collected tools either fall in the category of the Soanian or in the Acheulian. This is not true. The handaxes and cleavers are there, so are the Soanian choppers, but there are also bifacial choping tools, scrapers, points, discoid, polyhedra and spheroids and small numbers of blades (6). The type of raw material varies according to what was locally available, especially quartz and quarzite.

Soan-Acheulian Dichotomy in the Soan Valley: The sub-Himalayan region has been considered as a region of one of the non-Acheuilian LOwer Paleolithic industries, the Soan. A major focus of work on the Lower Paleolithic (or, the Early Stone Age) in Pakistan, therefore has been to understand the oSan phenomenon in relation to the Acheulian. Most workers consider that the Soan/ Acheulian

differences are related to bicultural differences, or adaptations to different environments. The discovery of a number of Acheulisan sites in the the Pothwar region, especially in the Soan Valley, has destroyed the geographical identity of the Soan (78.). As stated above, Rendell and Dennell (9) found handaxes at Jalalpur and Dina in the Jhelum basin in sediments just above the BruinsMatumayama boundary, and date them to between 800,000 to 700,000 years ago. Mohaputra finds that the Acheilian occurs in a geomorphic context which is later than the Soan, and considers that the Acheulian "just touched the outer fringe of the western Sub-Himalayas for a short while". He notices that while the Sienna artifacts are mainly made on cobbles, the Acheuilian utilized large flakes detached grom boulders for preparing bifaces.

While the distinctiveness of the Soan tradition is fairly well documented, the explanation of this variation is not well understood. Archaeologists have traditionally attributed differences in artifacts to differences in cultures, and have only gradually realized that in the Lower Paleolithic period we do not know if cultural differences existed. Presently, differences in raw material and preservation along with functional and use history of the artifacts are considered more variations in the Rendell (35) do not consider the Soan as forming a distinct entity from the Acheulian.
important factors Lower Paleolithic. in explaining

Dennell and
THE LOWER INDUS VALLEY AND THE COASTAL REGION OF SINDH

Acheulian Artifacts in Lower Indus Valley: The Early Stone Age tools are not confined to Pothwar alone. Their presence has also been indicated in other areas of Pakistan, especially in the Lower Indus Valley where rich paleolithic workshops are known from the Rohri Hills near Sukkur and Ongar near Hyderabad, some of which may be from the Early Paleolithic. The Italian Archaeological Mission to Pakistan, headed by Paulo Biagi and assisted by the Archaeological Department of Pakiassisted by the Archaeological Department of Paki 44). Birdget Allchin's field work in this area was limited but her insight in tying up the archaeological features of Sindh with other areas of interest around the fringes of the Thar Desert has proven to be quite valuable (45,46). Archaeological evidence for the Acheulian artifacts from the Lower Paleolithic is not very strong in the upper Sindh. Again, the stratigraphic evidence is only circumstantial and the chronology is pretty much muddled. In the followings, we attempt a brief review.

The Rohri Hills: Rohri Hills are a prominent area for Paleolithic sites in the Upper Sind. It is, however, not known for the Early Stone Age tools, Acheulian or otherwise. A few pebble tools of Oldowan type have nevertheless been reported from this area although their identification is still in doubt. Biagi et al have reported some artifacts from Unnar at Rohri Hills, which they think belong to the Lower Paleolithic period. All of these artifacts are of Acheulian tradition, none of the Soan.

At Unnar, a low hill situated along the southwestern edge of the Rohri Hills, the Early Paleolithic artifacts included one fragment of a handaxe with smooth surfaces, sinuous profile, broken at one edge and a few typical unretouched flakes with simple 'Clactonian' platforms. Red Hill, 300 meters east of Unnar, had the same morphological structure and "the top of the mesa was particularly rich in Early Paleolithic artifacts" (44). The Early Paleolithic type artifacts were also recovered along the hanging valley at the foot of the red soil deposits. Bridge Site, on the road to Sorah, at the western edge of the plateau, yielded the Early/Middle assemblage from the foot of the hills surrounding a valley some 300 meters wide (44). Side scrapers both on flake and blade as well as denticulate

scrapers are common to this assemblage, which also produced circular scrapers and cores. Finally, from Bunglow Kot, which is located a few kilometers south east of Shiraz, on the road to Sorah, on the eastern side of the valley, come the Early Paleolithic flakes from the top of the terrace.The site only produced unretouched artifacts" (44).

In the absence of a stratigraphic evidence, Biagi et al used laboratory analysis to distinguish the old artifacts from the relatively new. They demonstrated that at Rohri Hills clear relationships existed between age/type/physical aspect/distribution of the flint artifacts and the environmental changes which occurred in the region. The Early Paleolithic tools, which are scattered only at the top of the terraces, had a thick red patina, surfaces deeply modified by thermoclastic detachments, and eolisation exactly identical to that of the unworked chert blocks. The Early/Middle and Upper Paleolithic artifacts, in contrast, exhibited plainly visible polished surfaces as well as clear traces of eolisation. They were concentrated both on the terraces and along the slopes of the hills. According to Biagi's report: "The top of the plateau is covered with Early Paleolithic and Early/Middle and Late Paleolithic tools. Typical Harappan chipping floors are also abundant". Biagi et al also discovered in 1994 an early hand-axe factory site at Ziarat Pir Shaban. Broken and unfinished hand-axes and other tools and debris from their manufacture, including hammer stones, leave no doubt that this was a Lower Paleolithic, probably Chellean. This was a remarkable work as the presence of a true Early Paleolithic Acheulian industry had never been recorded from the Rohri Hills before this investigation.

Milestone 101 (Ongar): In lower Sindh, on the western bank of the present course of the Indus, near Hyderabad, there is a small group of flat topped limestone hills. One of these has a layer of chert nodules exposed on its top, like the Rohri Hills. It was discovered by an officer of the Pakistan Archaeological Department and, as it is not named on the Ordnance Survey Map, it is called Milestone 101. This site is also known as Ongar. Like the Rohri Hills, this site is located at source of high quality flint, on limestone hills. On present evidence, Lower Paleolithic artifacts appear to be more plentiful at this site where the rainfall is marginally higher than in the extremely arid Rohri hills of Upper Sindh.

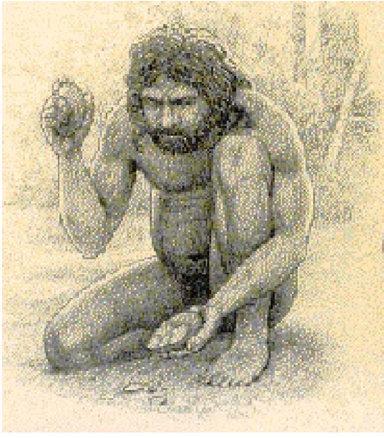
This site has produced an assemblage of stone tools, including handaxes and side scrapers on Clactonian flake, which have been assigned by Allchin to the Early Stone Age (45). Allchin and Goudie have made a case that the region was settled during the Early Paleolithic Acheulian Complex and that it was almost totally abandoned in the dry period that intervened between two relatively moister periods during the Early/Middle Pleistocene. We shall visit this subject again in the next chapter. The degradation of the soil which covered the Hills caused the dispersion of the Paleolithic artifacts and the complete destruction of any possibly existing man-made structures.

Judging from the surface patina of the tools, Biagi et al also came to the same conclusion. According to their study, the Early Paleolithic assemblages from Ongar indicate that the site was settled at least during two different times of the Early Stone Age. The earliest Paleolithic assemblages are represented mainly by rough hand-axes and chopping tools. The flat top is horseshoe shaped and extends to between one and two square kilometers in area. The chert nodules cover most of the top, except where they have been cleared by quarrymen, and give it the familiar dark appearance noticed in the Rohri Hills. The chert has a rust colored patina, sometimes mottled with black or cream colored patches, and is grey when freshly broken.

While we can make use of the extensive geological studies in the North of Pakistan to form an idea about the relative age of the stone artifacts, we do not have such a luxury in Sindh. Here all stone artifacts have been found at the surface and no stratigraphic information is available. In the absence of this point of reference, other criteria have been used, for instance the degree of patination on the artifact. This is, of course, conjectural and interpretations may differ.

Early Stone Age Tools in Baluchistan: A sequence of lower, middle, and upper Paleolithic industries has been reported to have been worked out in the Las Bela district of south Baluchistan and there are unconfirmed reports from other areas as well. What makes these reports *prima facie* acceptable is that there is detailed publication on an apparently pebble-based middle Paleolithic industry dominated by scrapers of different types made on quartzite, chert, and rarely jasper from the Ladiz and Mashkid valleys in Iranian Baluchistan just across the border (47). This industry - which has been called the Ladizian industry-demonstrates that the Baluchistan sector of the subcontinent is most likely to yield Paleolithic materials in future. Apart from the artifacts belonging to the Paleolithic, microliths of the Mesolithic type have been found at several places along the coastal line around Karachi as well as to the west. There have been, however, no systematic study so far.

VI.4. The Middle Stone Age Industries of Pakistan



The Middle Paleolithic is the second subdivision of the Paleolithic as it is understood in Europe. This term is often used as an equivalent or a synonym for the Middle Stone Age in African and Asian archeology (see Chapter V.1). The Middle Paleolithic period broadly spanned from 300,000 to

50,000 years ago in South Asian context but there are considerable dating and temporal boundary differences between regions. It was succeeded by the Upper Paleolithic subdivision which nominally began around 40,000 years ago in Europe and probably around 30,000 ago in South Asia, where it is more appropriately termed as the Late Stone Age.

TheMiddlePaleolithicperiodsawthe emergence of archaic Homo *sapiens* in Africa and Eurasia of which Homo *sapiens neanderthalis* in Europe has been studied extensively. The associated technology in Africa is generally more advanced in sophistication than Middle Paleolithic technologies in Europe; many Middle Stone Age assemblages are blade-based, have points, and several contain backed geometric *microliths*, and bone-working occurs. In Europe blades are not typical until the Upper Paleolithic, and microliths until the subsequent Mesolithic.

The Middle Pleistocene record in Pakistan is potentially one of the best in South Asia. It has been investigated for almost a century, far longer than in Africa and almost as long as western Europe. There have been some excellent studies of Middle Paleolithic landscape in northern as well as southern Pakistan, most notably in Pothwar, Peshawar Plains, and the Lower Indus Valley. However, in spite of the availability of this wealth of information and despite the strategic position of Pakistan in the overall picture of human evolution and dispersal, this region has not figured prominently in discussion on the Paleolithic industries or human dispersal in archaeological literature. The reasons for this neglect are many. The fossil hominin record of Pakistan itself is non-existence, that in India is limited to just a poorly dated partial hominin skull from the Narmada valley. Another weakness is that Early Paleolithic sites in Pakistan have proven difficult to date, and the shortage of reliable absolute dates means that the chronological framework for the Early and Middle Paleolithic still needs considerable development before it reaches the same standard as those for the Levant or western Europe. Still another reason is that ancient Pakistan has generally been treated as an historical hinterland of India and since India itself has not figured with any prominence in the discussion on human evolution, Pakistan did not do as well. Despite these shortcomings, there is now an adequate volume of literature on the Middle Stone Age that a fairly detailed history of human occupation of this part of the world can be sketched.

Tools and Implements: Middle paleolithic tools have been found in many parts of Pakistan, which give clues about prevailing climatic conditions. There are some dates for middle paleolithic contexts. In the north-west, lots of stone tools, mostly of the middle palaeolithic, have been found in the Potwar plateau between the Indus and Jhelum rivers. The over 3 m thick deposit in the Sanghao cave in the KPK province of Pakistan revealed a sequence of middle and paleolithic occupation. Thousands of stone tools were found, along with bones (of animals, some perhaps of humans) and hearths. All the tools are made of quartz, which is easily available around the site. Many of the tools of Period I were made from flakes stuck from prepared cores, and there were lots of burins.

In the Thar region, Middle palaeolithic artifacts occur in reddish brown soil, which indicates more abundant vegetation, more surface water, and a cooler, wetter, and more humid climate compared to lower paleolithic contexts. Small factory sites and camp sites have been found in various parts of the Thar, especially near rivers and lakes. A large number of stone age sites belonging to the middle palaeolithic phase onwards are located around Budha Pushkar lake, an area which offers advantages of the easy availability of water and stone. Didwana (Rajasthan) has given two thermoluminescence dates of 150,000 BP and 144,000 BP The Hiran valley (Gujarat) has yielded a uranium-thorium series date of 56,800 BP.

There were gradual changes in stone tools. Handaxes, chopping tools, and cleavers did not altogether disappear, but the balance shifted towards smaller, lighter flake tools, some of them made by prepared core techniques, including the Levallois technique. The chief characteristic of the Middle Paleolithic, or in our case the Middle Stone Age, is a shift in the preparation of stone tools from removing flakes to achieve a desired form to using the flakes themselves as tools. The Middle Paleolithic in Europe is associated with a particular type of flake tool industry, the so-called *Mode 3* technology. The essential feature of this technology is the suitable preparation of the core before flakes are struck from it. The flakes were then further modified into both simple and complex tools. The tools so produced are generally known in Europe as Mousterian and the core preparation technique is commonly known as Levallois technique (see Chapter V.1). The use of this technique is believed to be a significant change in culture and shows an increasing growth of cognitive ability, as one that is using this method must be able to imagine the end product and maintain that image while conditioning the stone to the desired shape and end result tool.

We encounter the use of Levallois technique for manufacturing flake artifacts in the Middle Stone Age of Pakistan also but a direct duplication of European situation is in no way at hand. By working on fine-grained silicates with a bone or wooden hammer rather than using the earlier stone-onstone technique of hand-ax or chopping tools production, it was possible to produce a thin, evenedged flake. These flakes made excellent cutting tools, and they were also frequently retouched to make scrapers, points, borers, and awls. Such tools represented not only an important advance in efficiency but also generated a large array of taskspecific tools rather than multipurpose implements.

Mousterian stone tools are found in the Soan Valley, Sanghao Caves, as well as the Lower Indus Valley but the assemblages are not dominated by these tools. What we detect is a general impression that the residents of these areas were using the Levallois technique for making their flake scrapers, burins, points, and other utility articles while still adhering to the choppers and chopping tools in Pothwar and to Acheulean artifacts in Sindh. In Europe, the Mousterian thrived between 90,000 and 30,000 years ago. In Pakistan, no such date can be fixed: the period between 300,000 and 30,000 could be taken as a good guess.

Blades are another type of stone tools that started appearing in Europe with greater frequency during the Late Middle Paleolithic. Blades are found in some Acheulean contexts in Sindh but these are not common in the north. There are few shaped tools, and the type of projectile points that are such a distinctive feature of the African Middle Stone Age are absent, both in northern as well as in southern Pakistan. Burins were an important component of the equipment of Middle and Upper Paleolithic of Europe. They were probably used in making the bone needles and other tools, which were necessary for sewing carefully tailored skin clothing and boots without which life in many of these regions would have been impossible (48).

In Pakistan, the tools of the Middle Paleolithic, or more accurately the Middle Stone Age, are largely based on flakes and blades and they are found in the North as well as in the South. These tools were made by finely trimming the edges of flakes and blades. Many of these tools are believed to have been used for manufacturing wooden tools and for processing animal hide. In general, tools became smaller, thinner and lighter. This, however, does not mean that the Acheulian and Soanian tooltypes based on pebbles and cores did not continue in the Middle Paleolithic level; they did, but the basic distinctive feature of the later assemblage was an emphasis on flake.

In the North, especially in the Pothwar region, scrapers of various types, points, and burins are found in abundance, of course mixed with Soanian. In the South, these tools are found at various sites mixed with Acheulian tools. The Peshawar Valley furnishes a variety of stone artifacts without the presence of Acheulian or the Soanian, indicating the in-migration of hominins in this area during the later part of the Middle Pleistocene or, alternatively, a strong *in situ* cultural change, probably caused by environmental change. The archaeological outline is, however, not crisp; there are some notable gaps and often a notable confusion. This situation most likely stems from the possibility of periodic emigration or extinction of hominins from these river valleys and hilltops, followed by re-colonization. Another factor is, of course, the effect of natural agencies in preserving, collating, and spewing forth some selected artifacts instead of offering us the whole gambit. All in all, we do not see a smooth transition in technology but change there is.

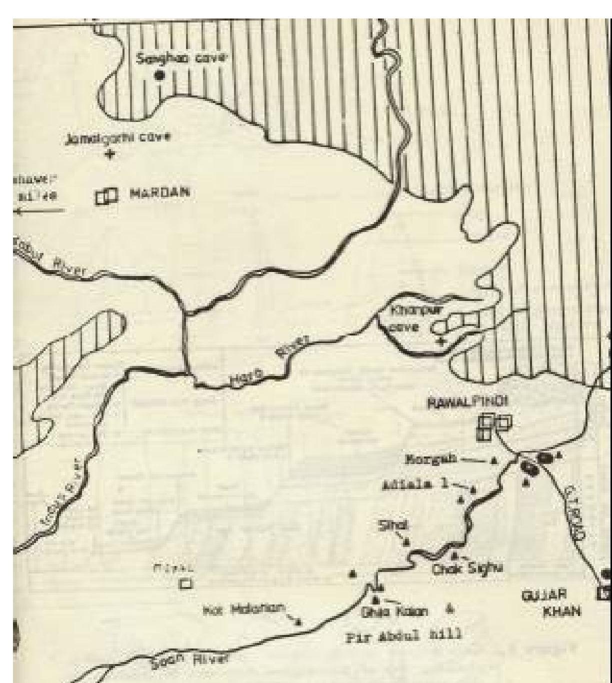
Burins appear only rarely in Middle Stone Age assemblages of southern Pakistan and the Pothwar region but are a significant component of the assemblage from Sanghao Cave. They are made from convenient fragments of tabular quartz, frequently using one of its natural facets as a striking platform, and many show signs of heavy use on the burin edge. The situation in southern areas is rather ambiguous but it is inconceivable that any tool collection in the Middle Stone Age could be without any pointed flake: one would expect that in an industry which lacked burin some other tool would be found to perform its functions, and in southern Pakistan (and most probably in Pothwar as well) the most likely candidates seem to be the beaked tools so persistent in industries from the end of the Early Stone Age onwards.

As an alternative explanation, the virtual absence of burins and pointed stone tools in the South may indicate that some material other than stone was employed for points, and in all probability this material was either bone or some kind of hard wood. In South-East Asia even to-day bamboo and other hard woods are widely used for a variety of purposes, ranging from arrow-heads and spearheads among hunting peoples to the bamboo knives in daily use by peasants and villagers. Similar practices may well have prevailed in Middle Stone Age of southern Pakistan, where it can be seen as a natural corollary of the general character of the stone industries of the period.

If we revert to one of the basic works dealing with the Middle Paleolithic in the Indus Valley, and take into examination the environmental picture that is commonly provided for the Middle Paleolithic of the Lower Indus Valley, and more generically the Great India Desert, the Thar, this period is supposed to have "seen a more humid climate with dune stability and with through-flowing rivers in the Thar Desert" (45), although the long Middle Paleolithic humid phase was preceded and followed by arid phases of some severity. The variation in environmental conditions that these changes imply must have been such that during an aruid phase the central parts of the hTar and the Indus basin, excepting possibly the area within daily reach of the river, virtually uninhabitable (45).

Middle Stone Age Sites,: The Middle Paleolithic sites are abundant in the Pothwar Plateau and the Salt Range and they have been extensively investigated since 1938. Several cave sites, belonging to the late Middle Stone Age have been recorded in the Salt Range, Mardan District and Bajaur Agency but only one site, i.e. the Sanghao Cave, has so far been excavated. In the Lower Insouthern Pakistan, especially the area that lies between the Indus and the Aravalli Range in the Thar. In the followings, we review some of the Middle Stone Age sites in very general terms, concentrating on the regions of interest rather than specific sites.

Evidence from the Pothwar Plateau: The geography and environment of Pothwar Plateau, especially that of the Soan Valley, has been amply discussed in the preceding pages. This area also appears prominently in Chapter VI.2. in connection with the Early Stone Age of northern Pakistan. In the Middle Stone Age, the Siwalik Hills, Pothwar, and the Soan Valley still remain the center of our



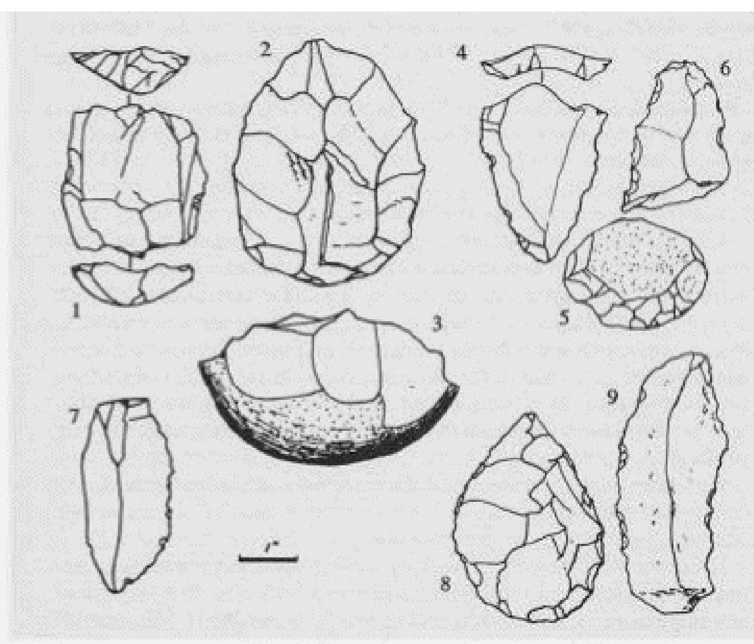
Late Soan tool types (after de Terra and Paterson)

1-3—Late Soan A cores

4-6—Late Soan A flakes

7—Late Soan B flakes

8-9—Chauntra finds



Middle Stone Age artifacts from Pothwar: late Soan type tools (de Terra)

attention although now the Sanghao Caves and the Lower Indus Valley also call for some of our attention. In this discussion, when we talk about the Pothwar region, we include in it the Salt Range as well as the its upper reaches into the Siwaliks. This whole area has been studied very extensively, especially for the lithic developments in the Middle Stone Age. Salim reviews these studies in his excellent monograph, *The Middle Stone Age Cultures of Northern Pakistan* (6). Quite an extensive and detailed work was done by the British Archaeological Mission in Pakistan during the 1980s and these findings have been published by Dennell, Rendell,

Distribution of Paleolithic sites in Pothwar and Peshawar Valley

dus Valley Middle Paleolithic assemblages are known from only a few well-defined regions: the Rohri Hills, in upper Sindh; Ongar, south of Hydera bad; and the Multi Hills, Deh Konkar and Ladhi, near Karachi, close to the Arabian Sea coastline.

There are a few sites in Las Bela which have been mentioned in archaeological literature but none of them have been properly surveyed or described. These sites, when investigated, could have a strong bearing on the Middle Paleolithic of Allchin, Hailwood, Hurcombe, and other members of the Mission in various journals and reports. Three aspects are noteworthy about these deliberations:

a) The nature of Soan Industry and its development in the Middle Stone Age.
b) Acheulian tools tradition, as it applies to this general area
c) Soan-Acheulian dichotomy Each of these topics is an involved subject and is relevant to the prehistory of Pakistan. Here we shall point only to a few specific tool types and mention a few archaeological sites. For detailed discussions, one should go to the original reports, referred to here.

The Late Soanian Tradition: The Early Soan industries have been placed in the Early Stone Age of Pakistan, discussed in the last chapter. The Late Soan industry belong to the Middle Stone Age period of which scores of sites have been recorded in Pothwar and the Salt Range. Twenty sites were recorded by de Terra and Paterson for Late Soan tools and Salim (6) adds to the list quite a few more.
Most of these implements come from the upper parts of the Pothwar loess, silts, and clays and the bulk of these artifacts are flakes, probably used as scrapers. The collections and assemblages from Late Soan are more numerous than Early Soan and contain both pebble tools and flake tools. Patterson recognized a small number of retouched flakes, mostly with cortex on their dorsel surfaces and on butt. He also illustrated a Levallois point, a few side scrapers and some denticular flakes.
Tools of Acheulean Tradition: Pothwar is the primary domain of the Soan Industry and the technologies derived from this basic tradition. Surprisingly, however, tools of Acheulean tradition have also been found at a few locations in conjunction with the Soan artifacts. For example, in late 1930s de Terra and Paterson made a number of handaxe collections from the surface of a deposits which they called T1. They identified the heavily rolled handaxes as 'Abbevillian' and those fresh in appearance as 'late Acheulean'. This typological distinction was, however, not supported by stratigraphy, as the tools were found together. The term Abbevillian was later dropped.
Soan-Acheulean Dichotomy: Salim (6) lists some 16 localities in the Pothwar region where Acheulean handaxes have been found. The prominent among them are Milestone 163 GT Road, Adial 1, Chauntra, Balwal, Morgah, Khasala, Makhand, and, of course, Dina and Jalalpur, all but Dina and Jalpur on the surface. At some of these locations, the Acheulean tools are found in association with Early and Late Soan tools. Another noteworthy observation is that both the primitive looking handaxes
- heavy, massive, crudely worked and pebble-butted
- and the better, more refined with regular outline, flatter flake scars and the cortex completely removed, are found together; and that the better handaxes of superior technique are found in the earliest deposits. A third observation is that some of the very earliest Acheulian and Soan assemblages in Pothwar contain numerous Oldowan-type pebble tools and it is possible that the Acheulean developed from this older industry. Acheulian tools did not entirely replace Oldowan tools in Africa; archaeologists have discovered numerous sites where Oldowan tools were used throughout the Acheulian time period, sometimes in the same geographic

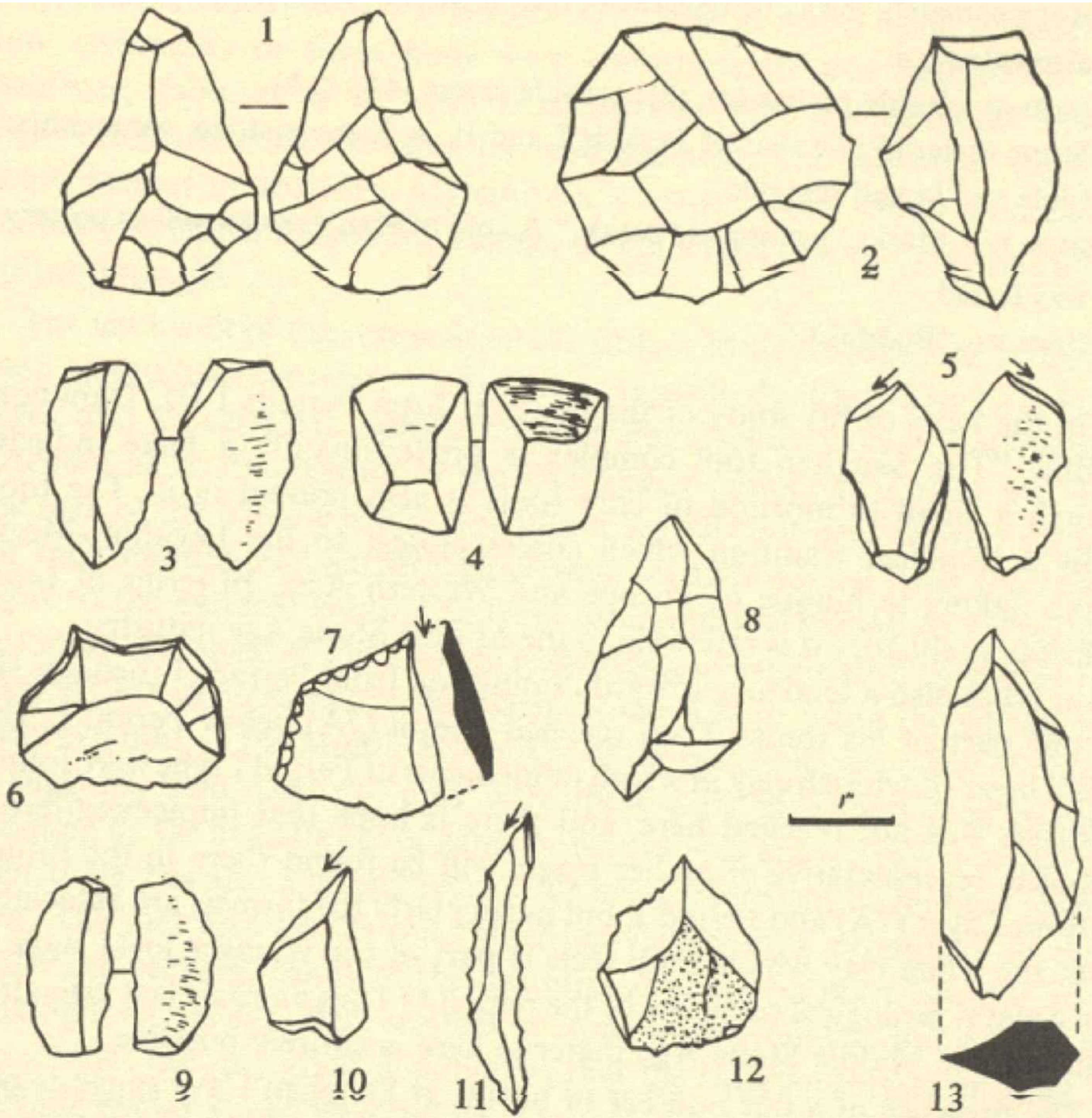
region as Acheulean industries. In a similar way, the Acheulian industry did not replace the Soan industry in the Pothwar region and coexisted with it for a long time.

The association of Acheulian tools with those of the Soanian type have puzzled archaeologists for a long time because the former represent the ‘western’ technological influence while the latter represent the ‘original‘ African legacy in the general picture of human evolution and dispersal. This has been viewed in the following alternatives:

1. Different human groups occupied the same site or area in different periods.
2. Paleolithic collections seem to be disturbed and redeposited from higher to lower levels
3. These tool kits represent functional variability by the same group of people.

The above possibilities, of course, come in question if we assume that the handaxes and pebble tools cannot belong to the same collection. Some researchers, such as Khatri (49), dispute this assumption and see no distinction between the two sets of collections. Others, like Mahaputra (50) confirm the existence of two separate traditions; that the Acheulian is found in hilly tracts, whereas Soanian is present in the Valleys. A third possibility is that the Soanian and Acheulian are two distinct toolmaking traditions but not contemporaneous. As Dennell (51) has pointed out, human occupation in most of the Old World was not continuous and that different human groups occupied the same site or area in different periods. This explanation is, perhaps, the most appealing at this time.

Sanghao Cave: The Middle Paleolithic of northern Pakistan comes in focus through the discoveries of Dani (52) at Sanghao Cave in Mardan District in the Pashtun country. He made stratified collections of quartz flakes and cores, along with charred animal bones. Dani defined the predominant industry as Levalloiso-Mousterian and placed the recovered artifacts in the late Middle Paleolithic

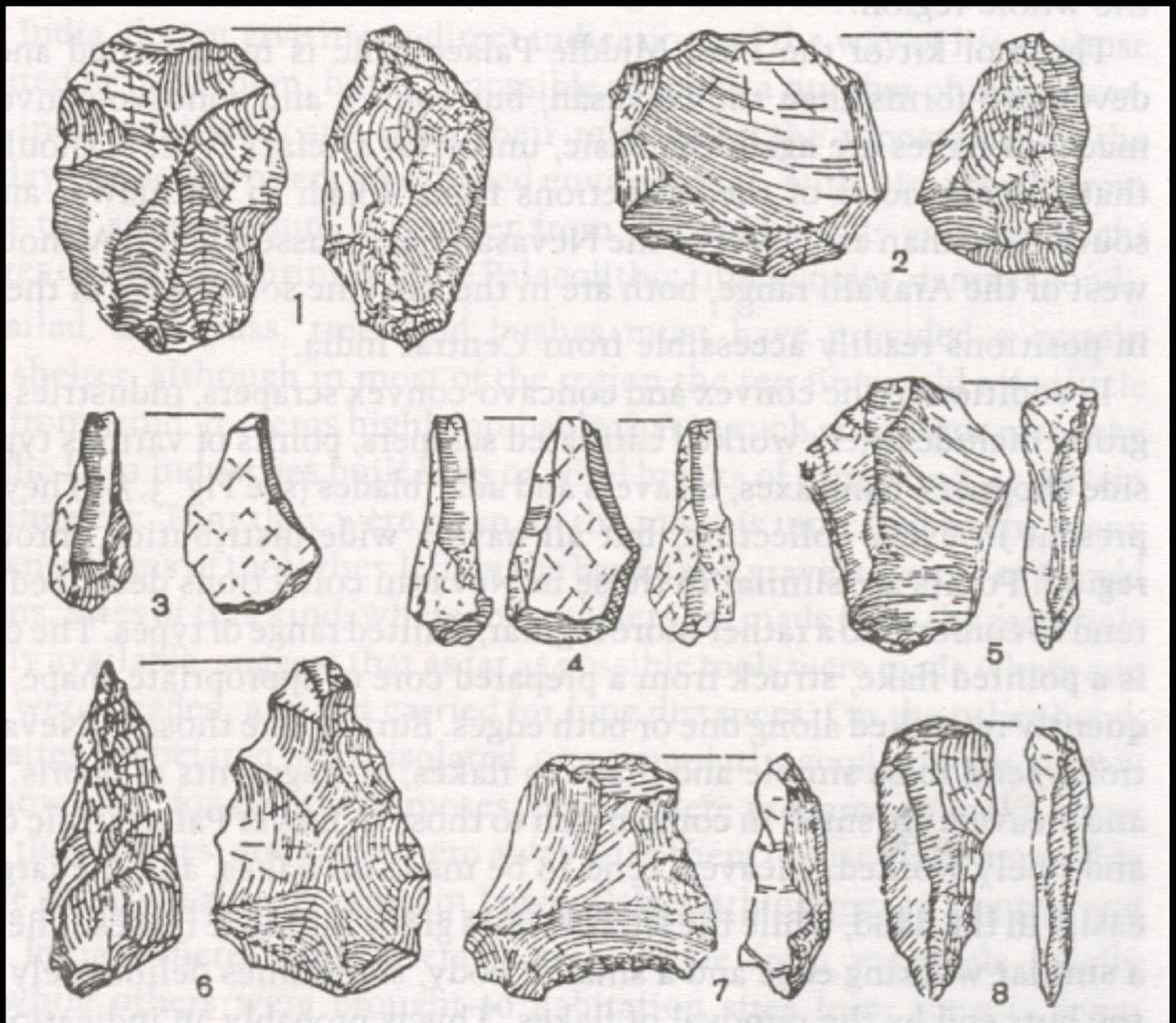


A sampling of stone tools from Sanghao Cave after Durrani. 1-7: Lower Paleolithic; 8: Middle Paleolithic, 9-3: Upper Paleolithic

period, during the last glacial, ca. 20,000-50,000 years in age. Here, a number of tools were made from flakes struck from prepared cores, which were generally round, oval or elliptical in outline. The lithic industry, almost exclusively made of quartz, included scrapers, notched scrapers, knives, gravers, burins, chisels, choppers, scraper-plains, points, blades, notched blades, flake blades, single platform cores, discoidal cores, blade cores, bipolar cores, irregular cores, hammerstones, and anvils. There were a small number of convex scrapers and one hand axe was also recorded. Cores and flakes of triangular outline are seen in small numbers and parallel-sided blade-flakes are more

numerous. One of the most interesting features of the industry is the burins, of which there are a considerable number. They are made from convenient fragments of tabular quartz, frequently using one of its natural facets as a striking platform, and many show signs of heavy use on the burin edge. Interestingly, burins were present throughout the lithic sequence. There is little purposeful retouch except notching - something understandable in view of the raw material being quartz. A number of untouched pointed flakes appear to have been used for piercing and boring, and a few flakes and quartz fragments have been carefully worked to a point and can be classified as awls.

At Sanghao cave the stone artifacts are found throughout the occupation together with animal bones, charcoal and ash. Stone tools and artifacts with signs of use were recognized from all layers and some bones with scratches and groves were also recovered (6). A number of hearths were found preserved in the lowermost 2 m deposit. Some burnt bones may indicate that meat was roasted after it had been cut from the animal carcass. The evidence may suggest that tools were not only prepared but also utilized for different activities like scraping, cutting and butchering animals. A large amount of debitage suggest that tools were more often prepared inside the cave.



Middle and Upper Paleolithic artifacts from Sangha Cave (after Allchins)

Of the total number of six layers reported in this excavation, the most important one seems to be Layer 6 which coincided with the formation of stalagmite in the cave and was based on a compact floor which was made of pieces of stone and set in a matrix of compact reddish sediment. This floor included a ramp providing access from the mouth of the cave to its inside. This ramp was found 'flanked by large stones arranged symmetrically at the edges of a flattened surface made up of small and medium sized stones' (52). Some scholars have taken these features as the beginning the use of permanent dwelling

The flake assemblage at Sanghao cave cannot be easily related to other lithic collections in Pakistan, as they are very different. It appears that the Sanghao cave remained isolated from the Soan valley, and on the present evidence it can be shown that there existed west of the river Indus another tradition and future research in this area is likely to reveal more of it and regional variants of the Sanghao-type Mousterian. There are some other caves in the Sanghao area. Although they have been surveyed,

none of them have been excavated. One rock shelter has recently been reported in Bajaur Agency in the NWFP and a few more are known in the Salt Range. The reports on them are, however, anecdotal.

The Middle Paleolithic stage was largely a period of cold climate. The formation of stalagmite during this period would suggest a cool but humid climate but this began to get increasingly cooler and less humid in the later layers. It is said that in the period of cold but humid climate only quartz tools were produced, whereas in the period of a cold and dry climate such tools were accompanied by a few limestone or quartzite tools which were classified as Mesolithic or Neolithic (61). Dani points out that the tools of this variety are widely distributed in the hill valleys of this region and represent the later stage, the Upper Paleolithic, of human existence in the region. He further argues that these prehistoric people appear to have moved in the same areas where later the Buddhists came and settled, and most probably they moved along the same routes. Quite significantly, he adds, “It is mainly in the track of the Buddhists ruins that we have been able to locate the prehistoric sites‘ (52).

The lowest strata at Sanghao contain pointed quartz flakes that resemble the widespread Mousterian industry of Europe and Western Asia. A cave, excavated in limestone at Darra-i-Kur in the hills of Badakhshan in north-eastern Afghanistan, helps authenticate the association at Sanghao. It had not only Mousterian flakes, but also bones of a hominins whose genetic affinities lie with the Skhul variety of Neanderthals identified at Mount Carmel, Israel. Thus, the occurrence of the LevalloisoMousterian cultures of Sanghao Caves as well as in Afghanistan, Central Asia and Iran not only extended its limits eastward but also strengthened the existence of a robust flake industry in the region (54). The proximity of the Mousterian site at TeshikTash in Tajikestan, on the other side of the mountains to the north, makes the prospect of future investigation of Sanghao cave an exciting one.

The inventory of caves in Pakistan with Middle Stone Age inhabitation is not large. The same applies to India; one such shelter has been reported in Chingleput District of Tamil Nadu. Unlike Sanghao, where the thick deposit implies continuous occupation, this site seems to have been visited only occasionally by hunters of big game and may have been a seasonal camp. Between the northern and southern extremes, the surface collections of flake tools from peninsular India and the Gangetic Plain suggest a widespread distribution of hominins. That they were fishers as well as hunters of big game is inferred from tools found on coastal sand dunes at the tip of the peninsula and near Bombay.

Eighteen radiocarbon dates by AMS technique on charred bone and charcoal samples were reported in 1990 and the results analyzed by Khan and Gowlett in 1997 (53). The age-depth plots of these samples led to two hypotheses: an age of 40,000 years ago at the base or an extension of this perhaps to 60,000 years. Culturally this reflects, according to them, a situation where the flake industries of the Middle Stone Age type were prolonged in duration and eventually followed by micro flake industries within the last 20,000 years.

If Sanghao and the Soan collections cannot be related to one another, we must venture into the neighboring regions to find parallels. Dani, for instance, regards the Cave culture to be generally connected with that of Afghanistan and western Asia, where the caves in Iran (55) have given stone industries of Levalloiso-Mousterian character. It appears that these industries having entered the Peshawar Valley, later proceeding southwards, thus giving the Middle Paleolithic of Pakistan a Western character.

The Sanghao flake industry of LevalloisoMousterian character is said to be widespread in northern Pakistan, occurring particularly in caves. Dani hence thinks that it implies a food-collecting stage, a

definite advance over the food-gathering stage.

Middle Paleolithic in the Lower Indus Valley: The distribution of Middle Paleolithic artifacts extends to the arid region west of the Indus, where they have been recorded in the Bugti hills and Las Bela district. The two most important Paleolithic areas in the Dry Zone, however, are the Rohri Hills near Sukkar in the upper Sindh and Mile 101 near Hyderabad in southern Sindh. Both of these areas have been investigated by Allchin and later by Biagi, although several other archaeologists such as Todd, Evans, Blanford, and Mughal, have also visited these areas in earlier times. Rich Middle Paleolithic sites have also been located in the nearby Didwana area in central Rajasthan, India. These discoveries have been reported by Misra and Allchin, among others. These sites, although not systematically investigated, shed useful light on the Middle Stone Age of southern Pakistan and on the activities of early humans during the Middle and Late Pleistocene.

A keen interest in the paleolithic sites in the Dry Zone of southern Pakistan and the adjoining areas in Rajasthan probably stems from the hope of finding general evidence for the presence of early humans on the fringes of the Great Desert and the coastal area of Sindh, which could be construed as the material evidence for the southern coastal migration route from Africa to East Asia. As indicated in the last chapter, the artifacts of the Early Stone Age were found at site Milestone 101 in the Lower Sindh only and these too undated. The artifacts belonging to the later times, especially to the Middle and Late Stone Ages, are, however, plentiful.

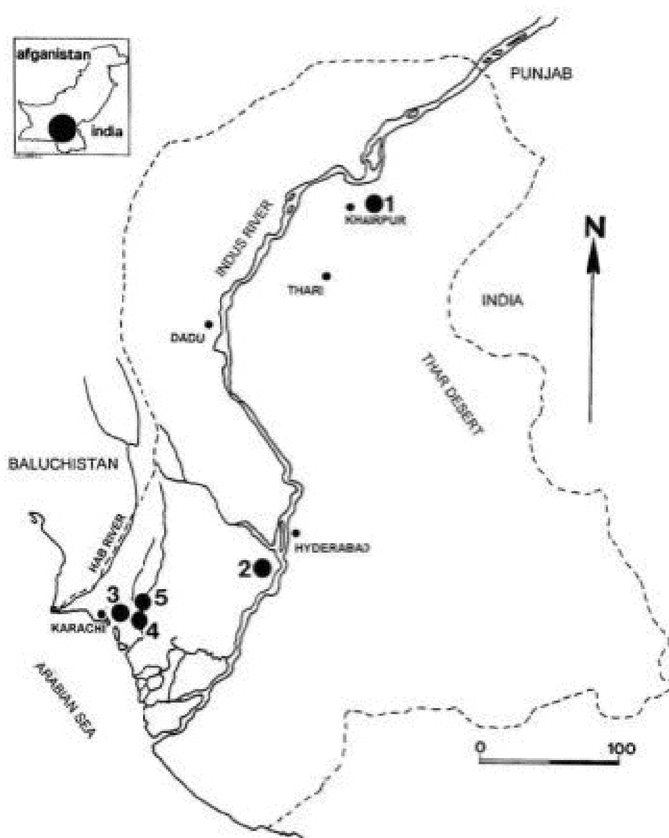


Fig. 1. Distribution map of the sites mentioned in the text: Rohri Hills (1), Ongar (2), Mulri Hills (3), Landhi (4) and Deh Konkar (5) (location approximate) (drawing by P. Biagi).

Distribution of Paleolithic sites in the Lower Indus Valley mentioned in this chapter (after Biagi)

Geographic characteristics of the Dry Zone at the fringes of the Thar Desert, the changing climate in the remote past, the ebb and flow of water streams and rivers in the area, and the pronounced variation in moisture level over rather long periods of times, have already been discussed elsewhere

in this volume. Here we shall concentrate on the stone artifacts of the Middle Paleolithic or, in general terms, the Middle Stone Age of Pakistan. The sites at the Rohri Hills around Sukhar and those at Milestone 101 near Hyderabad in Sindh are of particular importance as they have been extensively studied and reported. It will be clear that just as almost all the archaeological sites of the Middle Stone Age in Pothwar and the Salt Range fall into one single cultural group during the Middle Stone Age, so do the sites of the Dry Zone in Sindh, Las Bela, and Murri Bugti country more or less speak one lan



The Acheulian workshop of Ziarat Pir Shaban 1 (ZPS1). The Acheulian is a The Acheulian workshop of Ziarat Pir Shaban 1 (ZPS1). Paleolithic Culture (about 50,000 B.C.) characterized by the presence of bifaces

The Acheulian is a Paleolithic Culture (about 50,000 and handaxes. Very little is known about the culture. Excavations were carried out B.C.) characterized by the presence of bifaces and han here in March 1995. Thousands of flint flakes and bifaces were found (Biagi)

daxes. Very little is known about the culture. Excavations were carried out here in March 1995. Thousands of flint flakes and bifaces were found (Biagi**)**

reasons. Most of these sites are the so-called factory sites where early human made their tools and took them away with them for use. In all appearance, these were not their places of residence or camps. A feature of many factory sites of this kind is the way in which flakes or large pieces of rock were struck from boulders too large to be moved, or from outcrops of rock, and then worked into artifacts; or alternatively into cores from which further flakes were struck, which in turn were utilized or worked into hand axes, cleavers, scrapers and other tools.

The first Paleolithic sites at the Rohri Hills were described by de Terra and Paterson who collected Paleolithic artifacts on the top of the terraces west of the city of Sukkur. Bridget Allchin, in the winter of 1975-76, discovered many Paleolithic workshops close to the Bronze Age mound of Kot Diji, more precisely at Chancha Baloch and Nawab Panjabi (45). While nobody knows exactly where the first site was located, the real name of the second one is Unnar (or Unar). This site is of extreme importance because of its stratigraphic sequence and the discovery of heavily patinated Acheulean bifacial handaxes. Unfortunately this site was totally devastated by quarrying in the 1980s and all the lithic assemblages on its top removed and dis

guage.

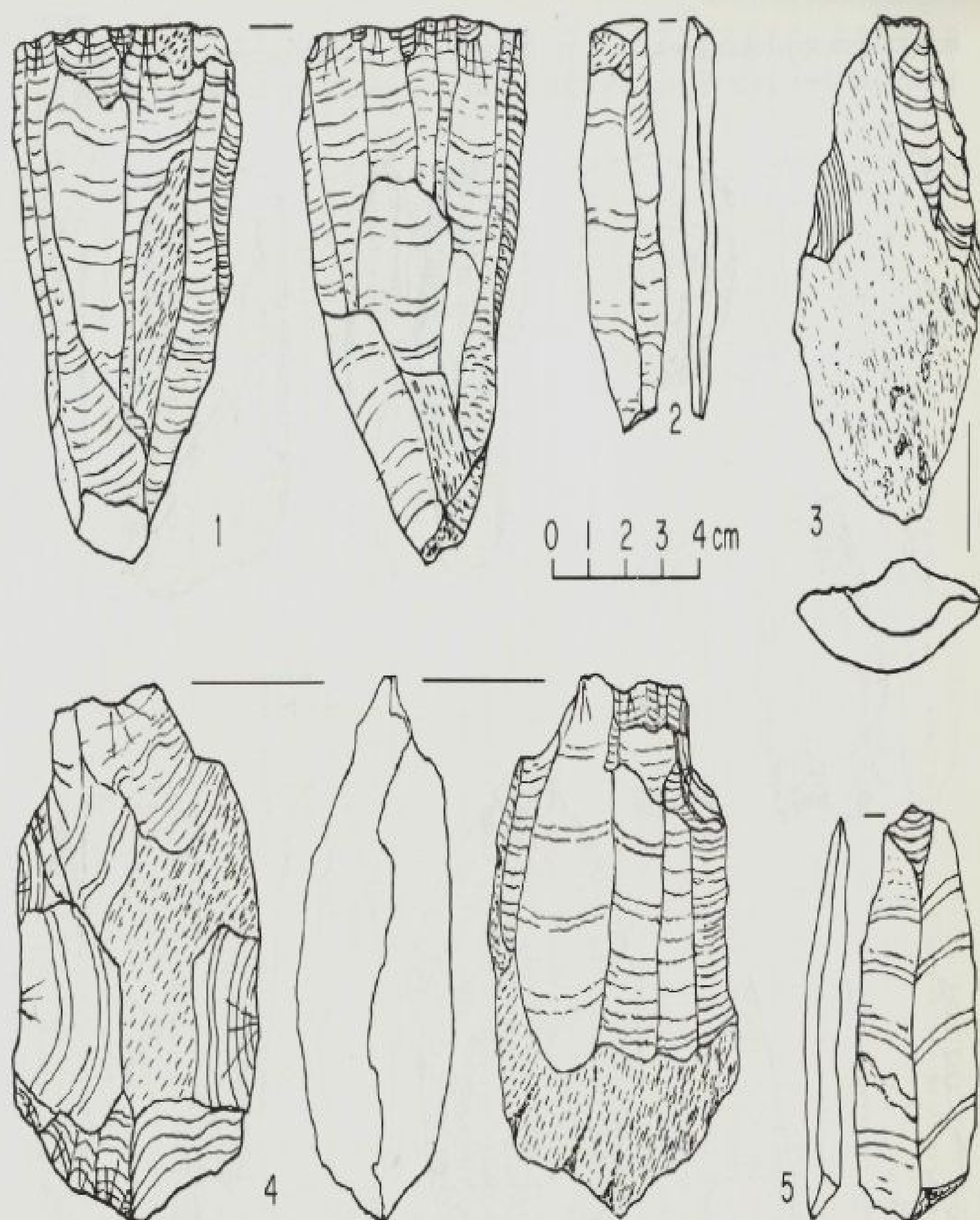


FIG. 8.7. Chancha Baluch, Rohri Hills, stone artefacts: 1, blade core; 2, 5, blades; 3, scraper made on a primary flake; 4, discoidal blade core.



Unfinished biface from Ziarat Pir Shahban. The exact date of the site is difficult to establish. It is reasonable to attribute it to the start of the middle Paleolithic period or

some 100,000 years ago (Biagi)
persed.

According to Allchin (45), the industry is based on the large nodules of chert that cap this group of flat-topped limestone hills. In terms of technological detail and of proportion of certain arti**Chancha Baluch, Rohri Hills, probably late Middle or**

early Upper Paleolithic stone artifacts 1: blade core; 2,5:
blades; 3: scraper made on primary flake; 4: **discoidal**

facts type, this industry differs quite a bit from those of Luni group on the other side of the Indo-Pak border as well as from those of the Pothwar Plateau and the Peshawar Valley in the North. For this reason she proposes a separate name for it: the Rohri

Factory sites at Rohri Hills: The vast ex
panses of chert in the Rohri hills, in Upper Sindh,
were extensively exploited in Middle and Upper Pa
leolithic times and again by Chalcolithic and Bronze
Age entrepreneurs; but they appear to have been
largely neglected during the Lower Paleolithic and
again during the Mesolithic, probably for climatic
Industry. Its distinguishing characteristics are the somewhat larger size of certain artifact types, and the tendency to use suitable nodules of chert as cores with little or no preparation. In some cases a succession of flakes has been struck off an unprepared nodule one after the other, rather like slices of bread but there is no indication for a prepared core A Paleolithic Journey

from which appropriate flakes have been struck.
This situation is quite different from the Middle Pa
leolithic of Europe and West Asia where the Leval

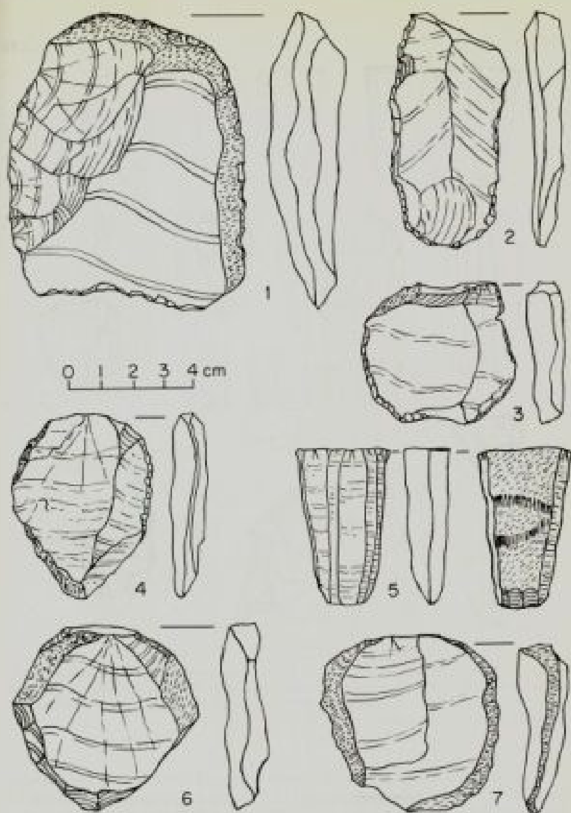
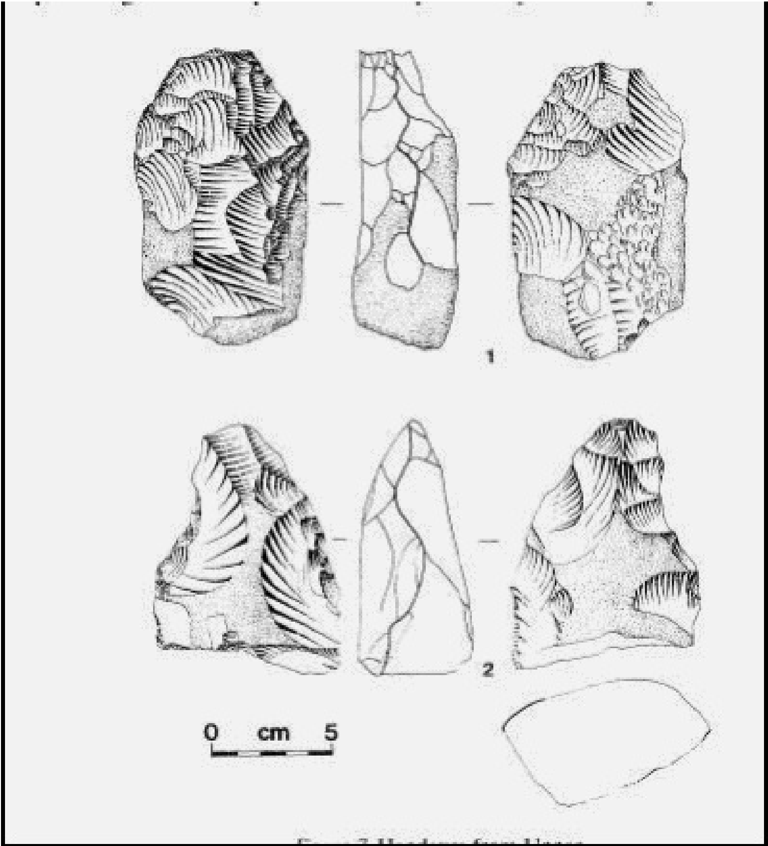


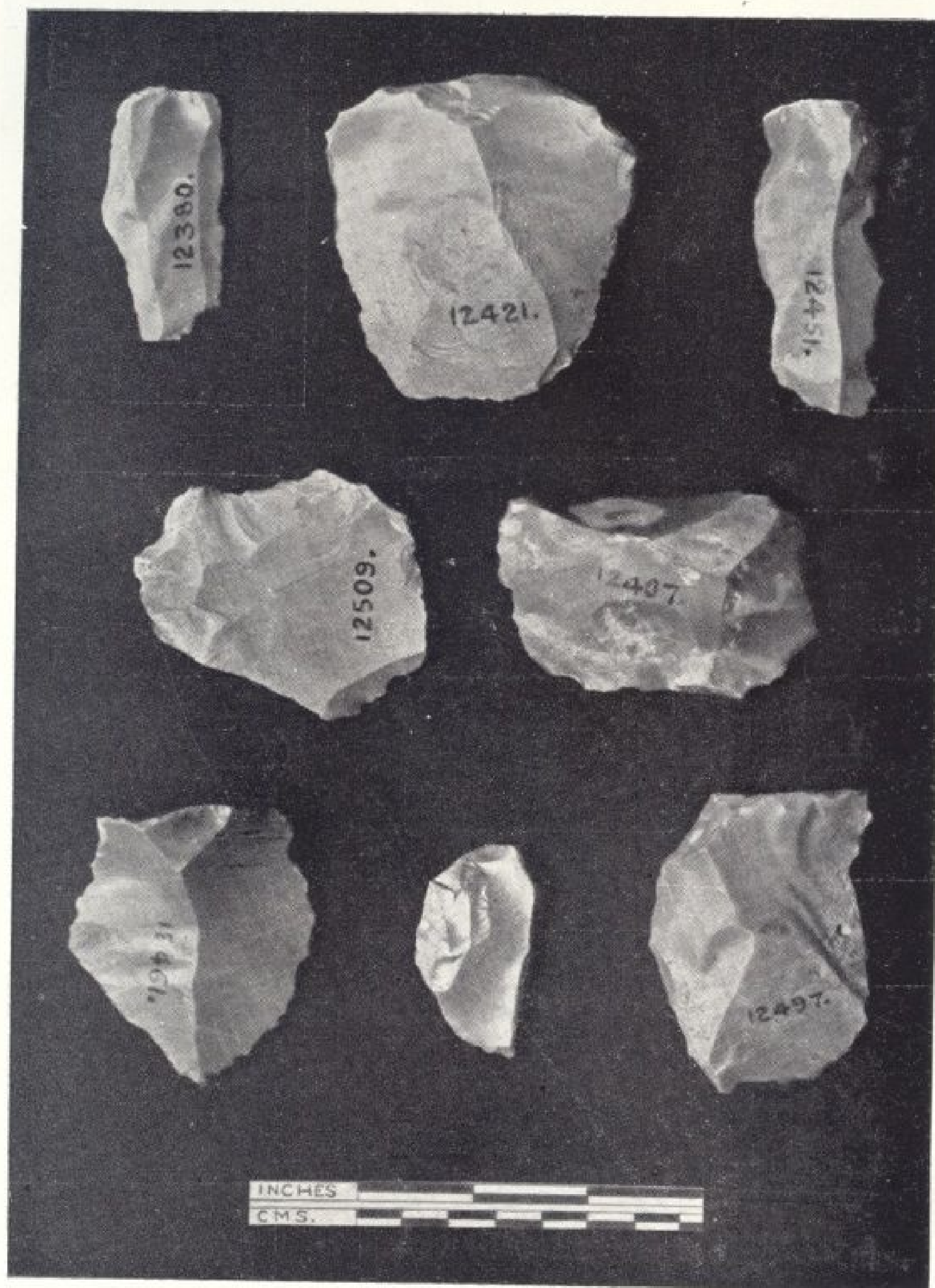
FIG. 8.10. Nawab Panjabi, Rohri Hills, general collection: 1, cleaver; 2, 3, 4, convex scrapers made on flakes struck from prepared cores; 5, blade core; 6, 7, flakes from previously struck cores, with cortex remaining round the margin in each case.

lois technique is considered to be a hallmark of the Middle Paleolithic. Later investigators and commen tators generally skirted the issue. Even the most recent reports on the subject are rather generic in describing the characteristics of this period. The statements like "… it may be divided in at least three developmental phases (i) the early Middle Paleolithic with artifacts of the Acheulean tradition (ii) middle Middle Paleolithic with artifacts made on flakes detached from prepared cores and discoidal cores and (iii) late Middle Paleolithic with a blade



Nawab Panjabi, Rohri Hills, general collection, Bridget Allchin

PLATE II



II. Retouched scrapers from Sukkur and Rohri—Indus Valley, Pakistan—from the Yale-Cambridge Collection, Indian Museum, Calcutta.
By Courtesy—Director General of Archaeology in India.

Handaxes from Unnar, Rohri Hills (*Biagi*) element in the assemblages" abound (56).

The discoveries made in the 1990s by Biagi and associates (40-44), before most of the sites were mercilessly destroyed by the nearby cement factories, are highly pertinent. During the same years Negrino and Kazi,(57) were able to establish a first chrono-typological sequence of the Paleolithic of Upper Sindh. It is important to point out that a huge Acheulian site, very rich in bifacial tools, discovered in Th.e same year very close to the eastern periphery of Rohri, along Th.e northern fringes of the hills, was destroyed in January-February 2001 without conducting any rescue excavation. A few artifacts were collected by Prof. G.M. Veesar of Shah Abdul Latif University, Khairpur and are now in the stores of the Archaeology Museum of the same.

The remarkable feature of the sites is their extent: many acres of flat hilltops are covered with
Some retouched scrapers from Rohri Hills

factory debris and broken or discarded Paleolithic artifacts. The social and economic implications of this concentration of sites are profound, for they far exceed all the other recorded sites in the arid regions of Pakistan, India or Central Asia put together in terms of quantity of artifacts and factory debris. They must have served a wide area, as well as being in use for a long period of time. Today the region is extremely arid, and almost entirely dependent upon the Indus for water. Even allowing for somewhat more hospitable conditions in the Middle Paleolithic times and for a certain concentration of population near the river, the products of such extensive working floors must have been shared by many different groups and communities. This in turn indicates a complex and far reaching system of social and economic relationships between the groups concentrated on a scale seldom envisaged for Middle Paleolithic man anywhere else.

This group of sites is of particular interest for another reason, namely that at one of them, Chancha Baluch, there is some evidence for a local development and emergence of the basic stone technology of the Upper Paleolithic. The presence of Upper Paleolithic artifacts on the same working floors as those of the Middle Paleolithic, and apparently made from the same material, by identical processes, argues strongly for the development of a blade and burin based industry being established within the desert region, instead of being imported from outside as advocated by many European ar

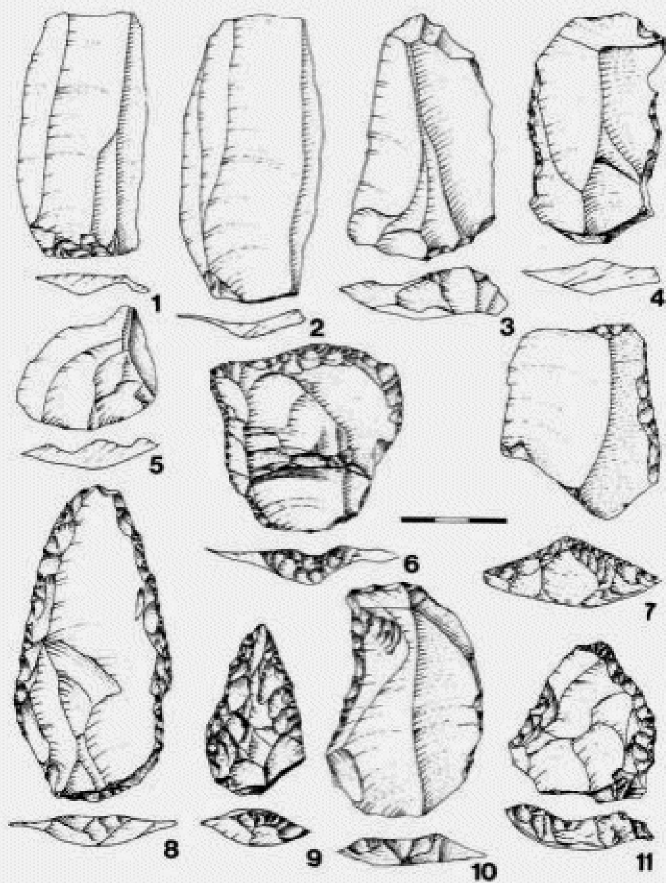


Fig. 4. Ongar: Levallois blades (1 and 2), flakes (3 and 5), scrapers (4, 6-8, 10 and 11) and 'Mousterian' point (10) (drawings by P. Biagi and G. Almerigogna).

Ongar: Levallois blades (1 and 2), flakes (3 and 5), scrapers (4,6-8,and 11) and Mousterian points (10), (*Biagi*) chaeologists.

A curious feature of the Middle Paleolithc assembIages of the northern Rohri Hills is the use of chert nodules of appropriate size as cores, with a minimal amount of preparation, often without removing the cortex. As stated above, flake after flake appears to have been struck from the same face of a large nodule in the same direction, rather like slicing bread. The likeness to sliced bread even extends to the cortex remaining round the entire edge of many such flakes rather like bread crust. In one case Allchin and her associates found two flakes of this kind that fitted together, lying side by side. Many such flakes have been reworked round a great part of their periphery by raking off very smaIl flakes that bite into the cortex crust without removing it. These appear to have been used as knives or scrapers. In classifying the collections, artifacts of this kind have all been listed as scrapers as no clear line of demarcation can be drawn in terms

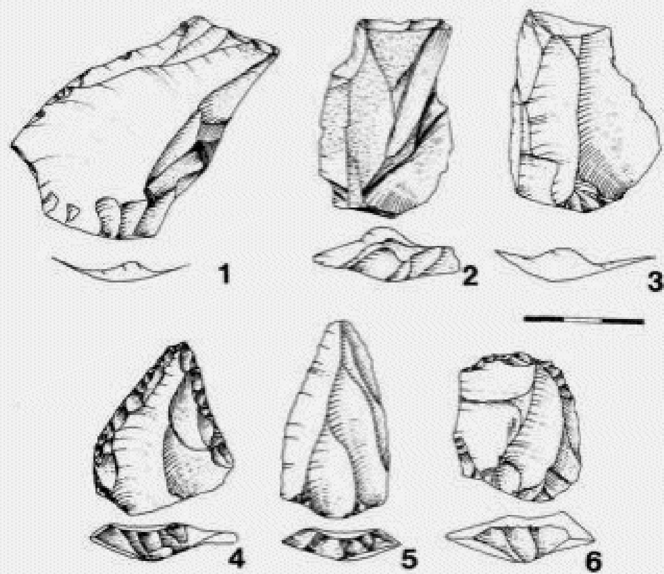

Ziarat Pir Shahban, an unfinished Acheulean core either of form or inferred function.

Bridget Allchin (45) seems to ascribe the assemblages at Rohri Hills mostly to the Upper Paleolithic, the blades and blade-cores of which seem to be a recurring feature at virtually all the sites. Yet, she points out the importance of the Middle Paleolithic workshops on the Hills and describes the main characteristics of the flake assemblages of this period, which are obtained from "chert nodules of appropriate size as cores, with a minimal amount of


A Late Acheulean hanaxe from Rohri Hills preparation, often without removing the cortex".

Surprisingly, the research carried out between 1993 and 2001 by the Joint Rohri Hills Project, revealed very littIe evidence of Middle Paleolithic tartifacts. Considering all this, one is compelled to conclude that the Paleolitic sites at Rohri Hills do not contain readily recognizable tools which are thought to be characteristic of the Middle Paleolithic everywhere else. Since it is unimaginable that these sites were not inhabited during the Middle Stone Age, the Middle Paleolithic of this area must be defined in other than Levallois and Mousterian terms.

Ongar or Milestone 101: The hill of Ongar, otherwise known as Milestone 101, is located a few kilometers south of Jamshoro, more precisely about 8 miles north of Jhirak, and a mile or 2 south-west of “Jhuga Pir", along the western side of the Indus River. It belongs to a group of flat-topped hills of Eocene formation, very rich in seams of flint nodules that were exploited throughout different periods of the Paleolithic, from the Acheulian up to the beginning of the Late Stone Age. At the present state of research, Ongar is the most important Paleolithic site discovered in southern Sindh. Biagi and associates conducted detailed studies at this location during 1980s and, on the basis of surface patina of the tools, they attireuted the flint assemblages to the Early, Middle and Late (Upper) Paleolithic periods. The earlier Paleolithic assemblages are represented mainly by rough hand-axes and chopping tools, while the later are to be attributed to the



Levalloisian assemblages of Sindh (Pakistan)... in the Middle Palaeolithic 1013

Fig. 5. Mulri Hills 3 (MH3): Levallois flakes (1-3); Deh Konkar: retouched Levallois point (4); Landhi: Levallois point (5) and Laki Range: transversal scraper on Levallois flakelet (6) (drawings by P. Biagi and G. Almerigogna).

3.3. The Karachi Gulf

The Levallois tools from this area are represented by a few specimens, three of which come from site MH3, in the Mulri Hills (Fig. 1:3). They elevate just to the south of the Karachi University Campus and consist of sedimentary bedrocks of the Miocene Gaj Formation (Zaidi et al. 1999), crossed by many faults. On their surface A.R. Khan (1979c: 64) discovered many sites, most of which have been attributed to the Mesolithic (Biagi 2005). The Levallois tools

Levallois flakes from Mulri Hills, near Karachi (*biagi*)

Acheulean culture.

If the presence of Levallois artifacts is any guide to the Middle Paleolithic, the site at Ongar is more pertinent for producing evidence for the Lower and the Middle Paleolithic than the Rohri Hills sites. The evidence for the Middle Paleolithic comes from the presence of Levallois tools, first indicated by Khan in 1973 (58), and later confirmed by Biagi (59). In the assemblage are: discoidal Levallois cores with centripetal flake detachments, different types of side and transverse scrapers on Levallois flake, urntouched Levallois flakes and blades and one 'Mousterian' straight point obtained with simple, deep, invasive retouch, covering the entire dorsal face.

Biagi must be credited for the extensive archaeological work at the Mileston 101, besides that done at the Rohri Hills, during his decade-long research in this area. His discovery of typical Levallois industries in Sind is of major importance for the understanding of the Middle Paleolithic of the western regions of the Indian Subcontinent. They are unique in this respect and do not find any close parallel with the Middle PaleoIithic assemblages at Rohri Hill or, for that matter, at any of the Middle PaleoIithic sites east of the Indus River.

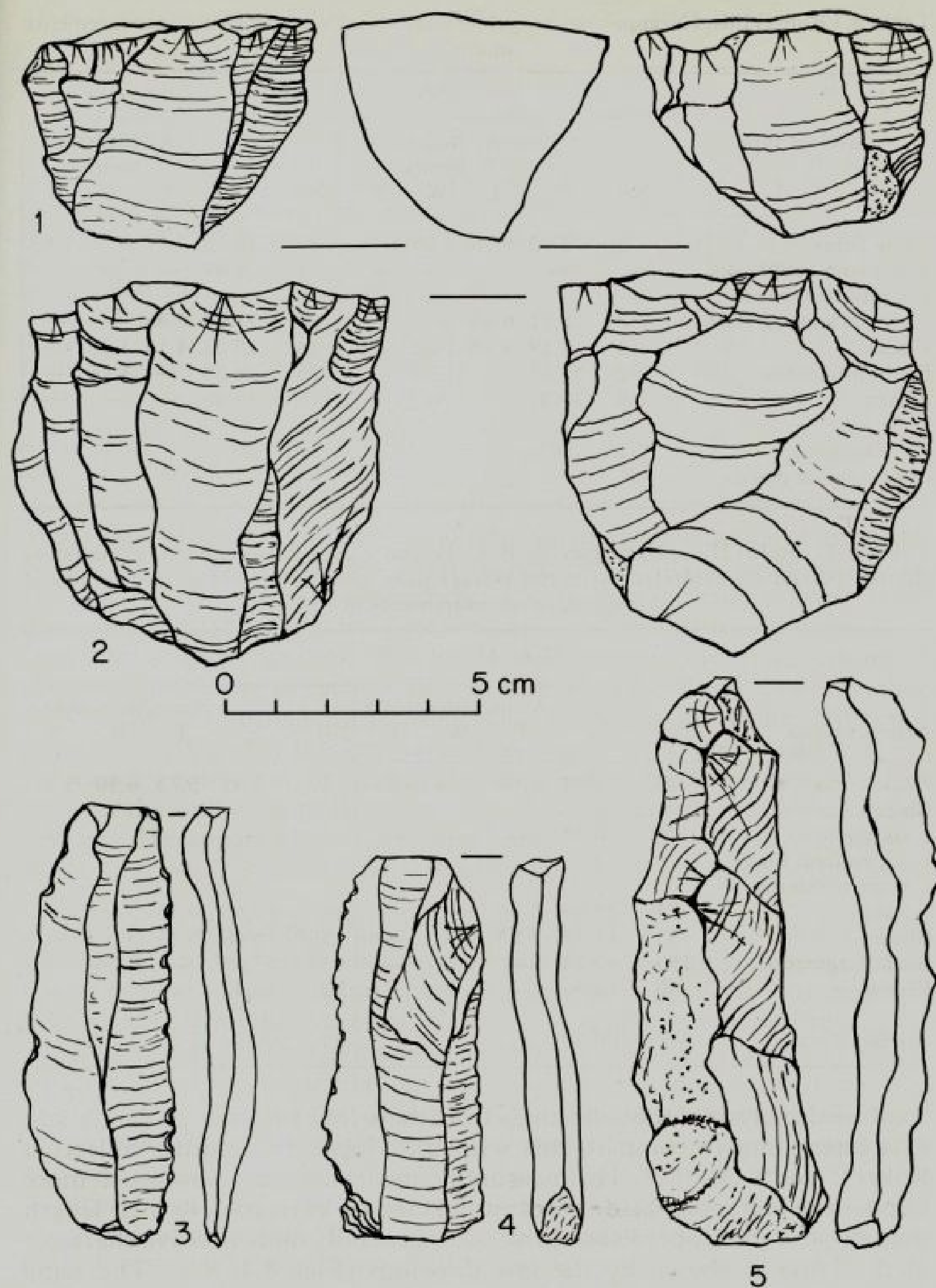


FIG. 8.5. Rohri Hills, Upper-Palaeolithic stone artefacts from a working floor: 1, 2, blade cores; 3, 4, blades; 5, primary longitudinal blade core trimming flake.

Milestone 101 stone artifacts: cleaver (1); blade core (2); flake struck from prepared core (3)

The Middle Palaeolithic of Sind is still of problematic definition from both chronological and typological points of view. Nevertheless, there is no doubt that the Middle Paleolithic of this region is no longer represented by "'an enigmatic group of stone industries which fall, typologically and stratigrafically, between the hand-axe industries on one side and the microlithic industries on the other" (60). Of course, there are still many problems to solve concerning the interpretation of the assemblages of this period. This is mainly due to 1) the scarcity of systematic research, and consequent finds, 2) the absence of multi-period stratified Paleolithic complexes, 3) the limited number of published colIections, 4) the paucity of Middle Late Pleistocene environmental data, and 5) above all to defining as to what really constitute Middle Paleolithic in the Dry Zone of southern Pakistan and adjoining areas in India.

The Middle Stone Age of Baluchistan: Nothing is known of the Middle Paleolithic of Balochistan. The only Paleolithic sites of this country are those attributed to the Ladizian, in south-east Iran (61). As Bridget Allchin speculates, it will be surprising if Middle Paleolithic artifacts are not found eventually in association with the channels of contemporary rivers flowing through the northwestern part of the desert, as they have been found to the north and west at Chauntra, near Rawalpindi, in the Northern Punjab, and at Sangao in Mardan district in the Pashtun country. (25). While Baluchistan enters the prehistory of Pakistan with a bang in the Holocene period, with its inventions of plants cultivation and animal domestication, coupled with sedentary living (see Volume II, *A prelude to Civilization*), its chapter on Paleolithic research is almost totally blank.

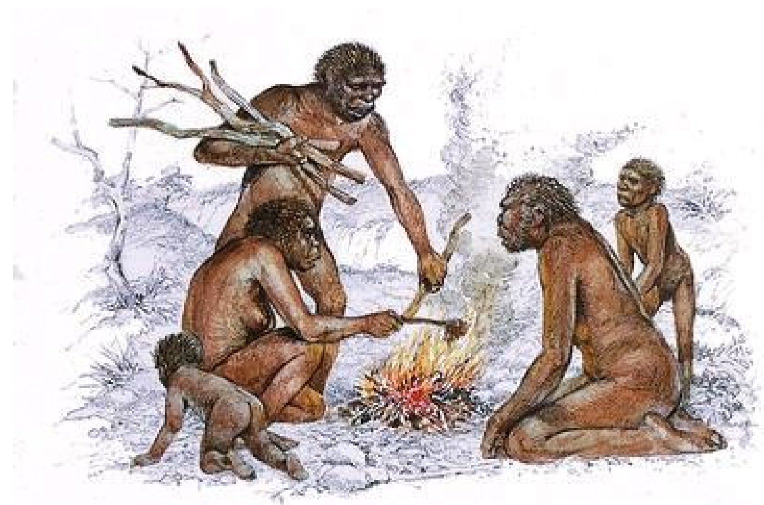
Concluding Remarks The Middle Stone Age of Pakistan (and that of India) probably developed indigenously, and without sharp demarcation from the Late Achuelian and earlier flake artifacts. There is no evidence of any influence from the Levant, which is not surprising given that most of the intervening area between Pakistan and West Asia was probably uninhibited during the cold, arid period that dominated most of the Middle Pleistocene and given the vast deserts that separated southern Pakistan from Western Iran during this prolonged dry period. Much remains unclear concerning the human inhabitation in Pakistan during the Middle Pleistocene but it is certain that the area north and west to Punjab was inhabited, albeit sparsely. Thar Desert had expanded both in width as well as in length and these dry conditions must have made the human as well as the animal life difficult. Consequently, this vast area must have been abandoned by early humans during this long duration. The human population in Sindh and the adjoining area to the east as well as the west must have contracted severely and got confined only in some pockets along the the banks of rivers or along the shores of lakes.

As far as the lithic technologies are concerned, there seems to be no clear relationship between the techniques used in Pothwar, the Peshawar Valley, and the Lower Indus Valley, and those reported from western Asia and Europe. It is true that Levollois and discoid techniques of preparing cores were used in Pothwar and the Peshawar Valley during the middle and later parts of the Middle Stone Age. It is also true that there is evidence for Levallois technique in Lower Sind (59). But these instances are not very common and they, unlike Europe, do not define the Middle Paleolithic of Pakistan. Similarly, blades and shaped tools are found in some Acheulian contexts but these are also not common. These features distinguish the Middle Stone Age technologies of East Africa. Their virtual absence in any part of Pakistan defies any similarity with or influence from Africa.

Most of the Middle Paleoilithic of Pakistan is undated and much needs to be done to establish its duration as well as its internal phasing. Only one independent date is available from Pothwar that places the Middle Paleolithic somewhere between 400,000 and 700,000 years ago in that part of the country. A few dates are available from Sanghao Cave. These dates presumably indicate the other limits of the Middle Paleolithic, that is, *ca.* 30,000 to 60,000 years ago. There is no reliable date available from Rohri Hills or Ongar in southern Pakistan. The only indication from the neighborhood comes from Afghanistan, dating *ca.* 35,000 years ago. This date could be of some relevance to the Middle Stone Age of Pakistan in the northern regions but does not have any relevance to the Middle Stone Age of southern Pakistan.

On stratigraphical grounds, Middle Paleolithic assemblages are found overlying Acheulian ones at some sites in Sindh and overlying the Soan artifacts at almost all Paleolithic in Pothwar and the Salt Range. At Sanghao Cave, the Middle Paleolithic assemblages are found beneath the Upper Paleolithic but does not show the presence of any Early Stone Age industries beneath. As the changes between the Late Acheulian and early Middler Paleolithic are so slight, it may prove difficult to define when the Middle Paleolithic began in southern Pakistan. Similarly, the change from the Late Soan assemblages to the Middle Stone Age artifacts is so gradual and so ill-defined that the start of the Middle Stone Age in Pothwar is not clearly in sight. The stratigraphic readings from Afghanistan and India are also of no help.

VI.4. The Later Stone Age of Pakistan



Archaeological evidence in Africa, Western Asia, and Europe shows that until about 50,000– 40,000 years ago the use of stone tools seems to have progressed stepwise: each phase

started at a higher level than the previous one, but once that phase had started further development was slow. In other words, one might call these *Homo* species culturally conservative. After 50,000 years ago, a sudden change in the pace of cultural change seems to happen. The tool kit grew larger, until at the end we are confronted with literally dozens of different styles of axes, borers, choppers, knives, scrapers, notched instruments with stone blades, chisels and planes - not to mention the really increasing evidence of the importance of antler and bone as weapon and tool materials. All this change seems to be happening within a short time. Jared Diamond, author of *The Third Chimpanzee*, characterizes this acceleration in the speed of cultural change as a "*Great Leap Forward*". For at least the past 30 years, most reconstructions of later human evolutionary history have subscribed to this relatively brief and dramatic cultural shift. Some authors have termed it the "*human revolution*" while others have called it an "*Upper Paleolithic Revolution*", reinforcing the idea of a Great Leap Forward (79-85). This behavioral breakthrough is thought by some to correspond to the beginning of increased cognitive sophistication, the manipulation of symbols, and the origin of language.

Jared Diamond (86) proposes that humans of the Acheulean and Mousetrarian cultures in the Middle Paleolithic period lived in an apparent stasis, experiencing little cultural change. This was followed by a sudden flowering of fine toolmaking and sophisticated weaponry. As human culture advanced, human populations all over the Old World began to create novelty in existing technologies. Artifacts such as fish hooks, buttons and bone needles begin to show signs of variation among different populations of humans, something that had not been seen in human cultures prior to 50,000 years ago. Along with a proliferation of tool types and the varied ways for their production, non-lithic aspects also saw some radical changes: humans started to bury their dead carefully, developed sophisticated hunting techniques, and sometimes even made cave paintings. Body ornaments and long-distance trade appeared. There was an abrupt and dramatic change in subsistence patterns also. Humans expanded into hitherto uninhabited environments, such as Australia and Northern Eurasia. This stunning change in cultural adaptation was not merely a quantitative one, but one that represented a significant departure from all earlier human behavior, reflecting a major qualitative transformation. It was literally a "creative explosion" which exhibited the technological ingenuity, social formations, and ideological complexity of historic hunter-gatherers.

The earliest remains of organized settlements in the form of campsites, some with storage pits, are encountered in this period in some regions. These were often located in narrow valley bottoms, possibly in order to make hunting passing herds of animals easier. Some sites may have been occupied year round though more generally they seem to have been used seasonally with peoples moving between them to exploit different food sources at different times of the year. Technological advances included significant developments in flint tool manufacturing with industries based on fine blades rather than simpler and shorter flakes. Burins and racloirs attest to the working of bone, antler and hides. Advanced darts and harpoons also appear in this period, along with the fish hook, the oil lamp, rope, and the eyed needle.

It is also time of increasing adaptability, when, for example, during the last major glacial advance in Europe and west Asia, human communities maintained themselves in many regions in the face of severe reductions in temperature or emigrated to more hospitable environment. In this respect, Pakistan appears to have been no exception: archaeological evidence in the form of reduced frequency of artifacts show a severe reduction in population and some even indicate total migration or extinction. For example, a reduction in population density have been observed in the Dry Zone of southern Pakistan. A similar reduction in population density, even total out-migration or extinction, has been noted in the Pothwar region. Allchin and coworkers (87,88) have assigned to this event a reduction in atmospheric moisture in the air and a drastic reduction in rains. Of course, these areas of attraction were recolonized once the glacial conditions ameliorated and somewhat warmer and wetter climate returned.

The Upper Paleolithic is generally defined on the basis of European experience. It is usually characterized by specially prepared cores from which blades (flakes at least twice as long as they are wide) were struck off with a bone or antler punch. Upper Paleolithic humans developed new forms of scrapers, backed knives, burins, and points. Examples of hafted pints, such as pointtipped spears, arrow-heads, and scrapers and blades with wooden or bone handle, are common in Europe. Upper Paleolithic tool assemblage also includes bone points, ivory beads, tooth necklaces, and abstract animal or human figurines in Europe. Assuming the parallel developments and other manifestations of culture as those in lithic technology, all these also imply a parallel refinement in clothing, shelters, and subsistence strategies. Furthermore, the Upper Paleolithic industry arrived in Europe with a bang, namely, a sudden appearance on the scene with little relation with the previously existing industries in the region.

These manifestations, often by default, have also been used to define the Upper Paleolithic in other parts of the Old World, including South Asia, although such an academic imitation is now less and less in practice. In spite of an headlong effort by early archaeologists and anthropologists working in South Asia, no such cultural package has yet been detected in any part of Pakistan or India, nor there is any sign of a sudden change, a ‘revolution’. The cultural and technological change is there but it is gradual and is largely based on the preexisting technologies. This means that, contrary to the situation in Europe, continuity in technological change is the name of the game. It is true that blades and burins make their appearance sporadically but they are not the mainstay of the technological change. Similarly, no specimen of hafted tools have been found in any part of Pakistan or India before the discovery of composite tools at Mehrgarh in 7,000 BC, well into the Holocene. It is only towards the end of the Upper Paleolithic (or, more accurately, by the end of the Later Stone Age), *microliths* (small, geometric-shaped blade segments) became increasingly common in many areas, including southern Pakistan and it is thought that they could have been used in the hafted condition.

This view of events stems from a profound Eurocentric bias in paleolithic research and a failure to appreciate the depth and breadth of the African and Asian archaeological record. Asia, including Pakistan, in particular, does not conform to this picture. Here we hardly see any radical change in artifacts at any one time; one type of tools merge into another and one type of technology gradually transforms into the new one. This applies to the time period which is generally considered to be the Late Stone Age as well as to that which is decidedly Middle Stone Age. However, since we are severely deficient in human fossils in Pakistan and the borderlands and since not very many secure dates on paleolithic sites and artifacts are available, it would appear that we do not have much of a choice but to define the Later Stone Age of this area in the idiom of Upper Paleolithic and take our reference point from Europe and West Asia, but always keeping in mind that The Later Stone Age of Pakistan, and, for that matter, that of India and Afghanistan, have had its own trajectory. This trajectory may touch upon the Paleolithic of Europe here and there but by and large it is an indigenous development. All this means that we must not look at the terminal stage of the Stone Age of Pakistan from the point of view of Europe.

Because of this compulsion, that is, studying the Late Stone Age of South Asia but really thinking of the Upper Paleolithic, most of the archaeologists working in India and Pakistan either deny the existence of any Upper Paleolithic period in the subcontinent or try to find some tell-tale signs in South Asia that define the Upper Paleolithic in Europe. Both of these approaches should be rejected. First of all, some Paleolithic sites in Pakistan, especially in Sindh and to some extent in northern Punjab (Pothwar) and the Peshawar Valley (Shangao Caves), are rich in typical Upper Paleolithic artifacts, such as sophisticated blades and burins. Secondly, the concept of an "Upper Paleolithic Revolution" or a "Great Leap Forward" is coming under increasing questioning and there is no more any compulsion to subscribe to this conceptualization.

This situation puts us in a fix: if there is no parallel, how do we define the Later Stone Age of South Asia or how do we identify the stone technology that defines the Upper Paleolithic of this region? There is no easy answer to this question except that we need to probe around and find our way through the artifactual maze while constantly looking for parallelisms that may or may not exist in the West. This is because, for now at least, we cannot avoid the Eurocentric reading of human history; it is there where most of the research work has been done and it there where this history has been written. We begin, therefore, with a short review of the European situation.

The European Upper Paleolithic and the Emergence of Modern Man: The transition from the Middle Paleolithic to the Upper Paleolithic is considered one of the major revolutions in the prehistory of humankind in the Near East and Europe. Explanations of the observable archaeological phenomena include biological arguments (the role of Cro-Magnons and the demise of the Neanderthals), as well as cultural-technological, and environmental arguments.

The Upper Palaeolithic in Europe and West Asia is the handiwork of *Homo sapiens sapiens;* it is virtually synonymous with the emergence of 'behaviorally modern man'. We are told that behaviorally modern humans first emerged in South Africa from where they dispersed to the Near East and then to Europe. This transition is dated to the Terminal Pleistocene with a time bracket of 40,000 to 35,000 years ago. It succeeds the Middle Paleolithic and precedes the Mesolithic. There is a starkly visible shift in technology. This includes the production of many parallel-sided blades from a prepared core and the manufacture of composite tools such as points, barbs and other tools from the blades. Unlike in the Middle Paleolithic this represents a sort of mass production - a core once

prepared could be made to yield not one but many blades before additional flaking is required. Bone tool technology including work on bone and ivory for tools and ornamentation, art represented by Venuses as symbols of fertility and of mother goddesses, and cave paintings came into vogue.

Upper Paleolithic Technologies and Cultural Change: The Upper Paleolithic is primarily recognized as a technological entity and is frequently described in European idiom. It represents a marked and fairly consistent change in methods of making tools, and in some of the underlying concepts relating to their use. This period of human history may also have reflected changes in associated crafts such as those of working woods, bone, leather, etc. Whether they are also related in hunting methods, or to a more general shift in the utilization of resources, are in most instances questions of further and more wide ranging investigation and discussion. Some of these questions have been more or less fully answered in the case of individual sites or localities in Western Asia, Europe, and elsewhere outside the subcontinent, but by and large they appear to have no complete or simple answers in context of Pakistan and certainly not so in context with the borderlands of Iran, Afghanistan, India and further on of East Asia.

As it is generally understood in Europe and West Asia, the Upper Paleolithic is characterized by an array of novel types of stone tools and rather complicated methods for their production. Of great significance are ground, polished, drilled, and perforated artifacts; bone, ivory, antler and shell ornaments; and stone, shaped into projectiles, harpoons, buttons, awls, and micro-borers. Such artifacts are extraordinarily rare in Middle Paleolithic sites but are a consistent feature of the Upper Paleolithic in East Africa, the Levant and Europe where more research efforts have been expended. Traces of more perishable materials, including string and woven fibers that may have been made into nets, ropes, bags, and clothing are also well documented in Europe. Other technological innovations include lamps (in the form of hollowed out stones filled with flammable substances such as oil or animal fat) and probably the bow and arrow (small projectile points have been interpreted as arrowheads). Many Upper Paleolithic artifacts appear to be evidence of composite technology, in which multiple components were combined together to form one single tool or process.

The archaeological record of the Upper Paleolithic in Europe shows a creative explosion of new technological, artistic, and symbolic innovations. There is little doubt that these populations were essentially modern in their biology and cognitive abilities and had fully developed language capabilities. There is a much greater degree of stylistic variation geographically and a more rapid developmental pace than in any previous archaeological period. Anthropologists hotly debate whether these new Upper Paleolithic patterns are due to biological transition or whether they are simply the products of accumulated cultural knowledge and complexity through time.

Equally important was the speed of these changes which is regarded to be so fast that it appeared to have a character of a revolution, thus an *Upper Paleolithic Revolution*. Furthermore, fossil evidence showed the appearance of anatomically modern man precisely around this time. A direct connection between particular lithic technologies and anatomical modernity of humans or a shift from the populations of archaic Homo *sapiens* with Middle Paleolithic technology to modern Homo *sapiens* and a more complex Upper Paleolithic technology, was therefore a natural outcome.

Blades and Burin Industry: Of all the tool types, blades and burin industry has been closely associated with the Upper Paleolithic, so recognized by the presence of this industry in west Asia and Europe. A blade is any flake more than twice as long as it is wide, although some investigators prefer ratios of

2.5 or even 4 to 1. The technical definition is somewhat narrower, limiting the use of the term to elongated blanks with parallel or slightly converging edges. Normally, technical blades possess one or more ridges running parallel to their long axes, giving them a triangular or trapezoidal cross-section.The sub-class of bladelets simply represents especially small, narrow blades. Although they may be made by very different methods, the distinction between blades and bladelets is generally based on an arbitrary size threshold: the maximum width for bladelets is generally set between 1 and 1.5 cm, depending on local assemblage characteristics.The "micro-blades" found in late Pleistocene and Holocene assemblages are often even smaller, and were produced by pressure flaking.

A burin is a special type of lithic flake with a chisel-like edge which prehistoric humans may have used for engraving or for carving wood or bone. Burins exhibit a feature called a "burin spall", in which toolmakers strike a small flake obliquely from the edge of the burin flake in order to form the graving edge. Like the blades and the bladelets, burin usage is diagnostic of Upper Paleolithic cultures in Europe, but archaeologists have also identified it in North American cultural assemblages also.

Blades and blade-like flakes can be manufactured in a surprising variety of ways but two methods, the Levallois and the prismatic, have most often been used in the Middle and Upper Paleolithic, respectively. These techniques have already been described in sufficient details in Chapter V.1. In Upper Paleolithic, the prismatic method of blade production was, however, the mainstay.

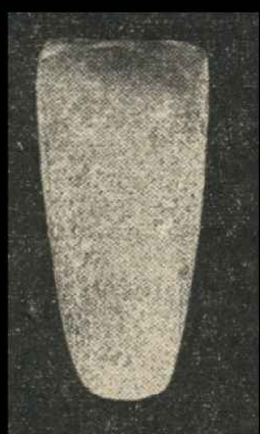
One good core, once prepared, could yield many parallel-sided blades with little or no further preparation. In this respect it was a distinct advancement on the Middle Paleolithic method, which was primarily a process of core preparation aimed at obtaining one flake of predetermined shape. Prismatic blade production substantially increased the number of usable sharp edges that could be obtained from a core. Standardized blade blanks were shaped into a diverse array of functionally and stylistically distinct tool types, often as components of tools of greater complexity.

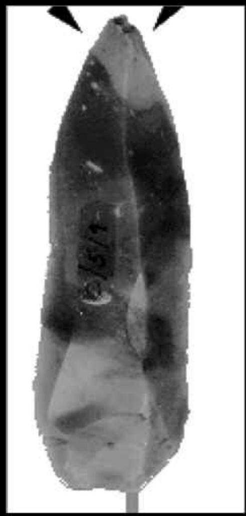
Prismatic blade production has often been described as offering marked advantages over other means of manufacturing blanks for stone tools. One potential strong point concerns the economy of raw material, the number of blanks that can be produced from a given unit of stone. It is frequently stated that prismatic blade production can provide a vastly greater length of usable edge per unit of raw material than other blank manufacture techniques. A number of additional potential advantages have been attributable to blade technologies. Prismatic core techniques, in particular, permit close control over the dimensions of blanks, sometimes resulting in a remarkable degree of standardization in the sizes and shapes of end products. Such uniformity of products could be a distinct advantage when manufacturing replaceable components of composite tools, a theme to which we will return. Laminar blanks may also provide greater potential for resharpening than flakes, particularly when the working edge is on the end of the blade.






6





may be relatively rigid and not especially "portable," or at least not appropriate for transport and sporadic, occasional exploitation. A large number of ‘factory sites’ around Rohri and Hyderabad is a witness to these observations.

This tradition of producing long blades of parallel sides and their various variations is almost universal in Africa, Europe, and the Near East during the Upper Paleolithic timeframe. In India the

Although they have some notable strong points, it is important to point out that blade technologies have a number of potential limitations as well. Blade production is risky, prone to "fatal" errors, mistakes that render a core useless without extensive reworking. The production of elongated, laminar blanks also tends to be quite demanding of raw materials. Long, thin blades are comparatively fragile, yet significant force is needed to detach them. The raw material must be brittle enough that a fracture will carry over the desired length of the blade, yet also sufficiently homogeneous and tough so that the blades will not shatter from the force of percussion or pressure. As a consequence, blades were most often manufactured on isotropic, finegrained raw materials such as flint, jasper, chert, and obsidian, although coarser-grained materials were sometimes employed if they were sufficiently isotropic. The need for homogeneous material may in turn require stringent selection or importation of raw materials, at some cost in terms of time or effort in many geological contexts. Properly setting up a face of detachment for blades often requires extensive preparation, placing further limits on minimum sizes of nodules. Finally, production of large blades blade industries are less common. Nevertheless, tools of this nature do make there presence known in Central India, although somewhat stubby and method of production somewhat random. Allchin (45,46,89) describes a method of blade production at the fringes of the Thar where a core is sliced like a bread without preparing it to any extent, but she describes it as a Middle Paleolithic industry in Sindh.

Blade Technologies and Human Evolution: The blade and burin industry has been inextricably linked with the Upper Paleolithic in Europe to an extent that they have become synonymous. If there is a blade industry, then it must be an Upper Paleolithic culture and we must look for the ‘modern man’; or, if there is the Upper Paleolithic, then we must look for blades. Blade technologies are thought to possess a number of inherent advantages particularly suited for the "complex" and "efficient" technological adaptations of modern humans, and they are frequently included in archaeological trait lists used to define "fully modern behavior" in the Upper Paleolithic.

Despite the rapid expansion of the Paleolithic archaeological record over the past 50 years and the inevitable effects of this increased knowledge on the systems of classification inherited from previous generations of prehistorians, this generalization has been remarkably tenacious and equating blade technologies with Upper Paleolithic industries and anatomically (and behaviorally) modern humans has acquired the status of an anthropological dogma. A heavy reliance on specialized methods

A typical blade of the Upper Paleolithic

**An end scraper**

**A point**

**A typical burin**

for producing elongated, parallel-sided stone flakes (or blades) is often cited in textbooks as a defining characteristic of the lithic assemblages of anatomically modern human populations in Eurasia and Africa. The manufacture and use of blades is seen by some as a major threshold in the evolution of hominin technological capacities, a watershed event in the development of "modern" behavioral repertoires.

Many assemblages from Europe, the Near East, and Africa provide evidence for the production of blades and laminar flakes during the Middle Paleolithic/Middle Stone Age, and even the later Lower Paleolithic although blade-based assemblages are somewhat scattered across both space and time prior to the Upper Paleolithic. At the same time, the recent prehistory of North America and Australia shows that blades are not part and parcel of complex, sophisticated or high-mobility adaptations of "modern" hunter-gatherers. Closer at home, examples from Early Soan, Late Soan, and Chauntra period of Pothwar region in northern Pakistan are also sited. Similarly, the chronology of the blade tools coming from the Rohri Hills is not clear and it is believed that not all of them belong to the Later Stone Age. Some of them may in fact belong to later times and some may go back to the Middle Stone Age. Likewise, some of the blades and bladelets found in the coastal region near Karachi may belong to a time period prior to the Later Stone Age in Pakistan.

Based on a review of the evidence from the Americas, researchers have concluded that blade manufacture in the New World was more commonly associated with specialist production in urban settings rather than with mobile hunter-gatherers. Even the European Upper Paleolithic, the source of ideas about the association between blade-based lithic technologies and modern humans, is not entirely uniform from this technological perspective. Early Upper Paleolithic assemblages from southwest Europe exhibit a wide range of variation in blank production. In northern Italy and Spain, the earliest assemblages contain large numbers of blades and especially bladelets. In the Near East, the

earliest Upper Paleolithic industries are heavily biased towards the production of elongated blanks. In South Africa blades are common early in the Middle Stone Age and occur in some Late Stone Age industries.

The long held and widespread views about the sophistication and utility of blade technologies and their exclusive association with anatomically modern humans and the Upper Paleolithic are based on observations of the limited and rather incomplete European archaeological record of decades past. Based on the archaeological record as it is known today, there is no clear association between the production of elongated blades - prismatic or Levallois and any single feature of hominid anatomy or behavior. Prismatic blade production is the dominant mode of blank manufacture in most parts of Europe and western Asia during the Upper Paleolithic, but forms of blade technology had been around for tens of millennia before the appearance of modern humans or the Upper Paleolithic, and other modes of blank production continue to be used throughout the world even after the origins of modern humans.

A question that naturally arises in the context of discussions of human evolution is whether blade manufacture is in some way more complicated than other forms of blank production, requiring a higher level of physical skill or cognitive sophistication. According to Bar-Yosef and Kuhn (91), there is no evidence to indicate that the manufacture of blades is intellectually any more demanding than the making of handaxes or Levallois flakes. Although some anthropologists have long argued that Levallois and prismatic blade technologies entail different conceptions of how to exploit the volume of a piece of raw material, few of them assert that one conception is more sophisticated or complex than the other. Bar-Yusef and Kuhn think (91) that “if prismatic blades appear to be complex and sophisticated, it may only be because they seemed at one time so closely linked with the appearance of modern humans.

Bar-Yosef and Steven Kuhn (91) have critically reviewed this long-held relation and have come to the conclusion that there was no justification in maintaining that the development of laminar lithic technologies *per se* was linked to the appearance of either modern anatomy or "modern" behavior. These well-documented but little-discussed global patterns call into question assumptions of both the significance of blade technologies in human evolution and the putative superiority of these technological systems.

Several points are clear from the Bar-Yosef and Kuhn’s review presented above. First, blades and blade technologies are not exclusively associated with the Upper Paleolithic or the Late Stone Age. Both Levallois and prismatic blade technologies are found throughout western Eurasia and the Siwaliks of Pakistan in Paleolithic assemblages dating back as far as the late Middle Pleistocene, or as early as 300,000 years ago. These early assemblages contain more than just a few elongated pieces: there is abundant evidence for stoneworking techniques directed specifically at the production of blades. Second, pre-Upper Paleolithic blade technologies are found in many regions of the Old World, including northern Pakistan. Although east Africa is home to one of the earliest cases of blade manufacturing from prismatic cores, bladerich assemblages of similar antiquity are known from the Near East.

The chronology of the thousands of blade tools recovered from the factory sites around Rohri Hills and southern Sindh has not yet been worked out. It would not be surprising if some sites are shown to belong to the Middle Stone Age. The blades from the Middle Stone Age in Pothwar are now a part of

its Paleolithic record, some of them span as far back as the Early Stone Age. Not only were true blades sometimes systematically produced in very early time periods, they are by no means ubiquitous among stone-tool technologies attributed to modern humans. The notion that laminar technologies are somehow integral to the sophisticated foraging adaptations of anatomically modern humans simply does not hold up outside of western Eurasia and North Africa.

Behaviorally Modern Man: Demarcating the origin of a package of recent human behaviors, such as complex language, symbolism and specialized technologies, has been central to much archaeological debate on the Upper Paleolithic over the past several years. We have already discussed this topic in Chapter II.4 in sufficient details; the followings remarks are of critical nature, bordering the theoretical. Originally focused on apparent contrasts between the Middle and Upper Paleolithic records in Europe, this concept has now been extended to the Middle - Later Stone Age transition in Africa and a number of archaeologists working in South Asia have also tried to interpret the South Asian terminal Stone Age in this light.

The archaeological signatures of Paleolithic Revolution are based on a list of behavior originally devised by Mellars (79,92,93). Among these, four ingredients define modern human behavior more than the others: abstract thinking (concepts free from specific examples), planning (taking steps to achieve a further goal), innovation (finding new solutions), and symbolic behavior (such as images and rituals). Among concrete examples of modern behavior, anthropologists include specialization of tools, use of jewelry and images (such as cave drawings), organization of living space, rituals (for example, burials with grave gifts), specialized hunting techniques, and barter trade networks. It seems that once promulgated, these indicators of modern human behavior were uncritically adopted and reiterated by other authors. Particular emphasis is placed on the evidence for symbolic behavior.

The presently dominant visualization for the origin and evolution of modern man is, of course, based on Out-of-Africa hypothesis and the technological development of modern humans is clearly Eurocentric. It is in Europe that the archaeological record reveals the emergence of technical and social advances which were fundamentally different from those of the Middle Paleolithic and which modern human can understand as essentially like his own..

Genetic studies indicating a recent origin for modern humans have reinvigorated interest in the archaeology of the Middle-Upper Paleolithic transition and how it is related to the emergence and dispersals of modern populations. Some researchers have correlated the extensive movements of modern human groups into or across Eurasia with concrete archaeological entities. The most significant population movement is considered as marking the advent of the Upper Paleolithic revolution.

The search for the causes and origin of this major cultural change has resulted in divergent perspectives. Some authorities suggest that this revolution was no more than a continuation of a process of local cultural change through time within each region. They surmise that the local populations responsible for Middle Paleolithic Mousterian tool kits independently transformed them into characteristic Upper Paleolithic industries. Such an explanation does not require any appeal to population replacements, as envision by the Out-of-Africa model for the emergence of modern humans. Other researchers accept the idea of prehistoric migrations, but nonetheless consider that endemic Neanderthal populations were capable of acquiring new technological skills, such as lithic reduction techniques for the standard production of blades, shaping of bone, and the production of

body decorations. Yet a different approach proposes that the Upper Paleolithic transformation was a major revolutionary event that took place in one particular region and from there eventually spread out to the rest of the Old World. While moving across Eurasia, the bearers of this new set of tools, often known as Cro-Magnons, influenced and replaced local populations. Dating the end of the Middle Paleolithic and onset of the Upper Paleolithic is crucial, at least in part, for testing these various models.

Research aimed at assessing the evolution of behavior remains concentrated on the contrasting records of Europe and Africa (94), the Near East being viewed as a transitional area occupied differentially by *H. neanderthalensis* and *H. sapiens* The complexity of the Later Pleistocene records of these regions argues that the evolution of humans and their behavior cannot be understood without an awareness of the demographic and bio-cultural variability in all areas of the world. Yet, the gigantic landmasses of southern and eastern Asia play little or no role in modern debates about the evolution of behavior. With recent work in eastern Asia suggesting a very different pattern of behavioral development from that seen in Europe or Africa the question of how South Asia fits within the variability of behaviors associated with the last 250,000 years is increasingly becoming important.

In recent years the actions that constitute "modern human behavior" and the extent to which they can be extrapolated from the archaeological record have come under active discussion. Archaeologists have become increasingly interested not only in the origin of the modern behavioral package but also in the geographical variability in the sets of traits that are thought to define cultural modernity. As a result of such research, the roots of at least some traits thought to be exclusively 'modern' have been found to stretch back into the African Middle Pleistocene (95). In addition, accumulating evidence suggests that hominin species other than H. *sapiens* exhibited some of these behaviors. The significance of such data to the modern-humanorigins debate is dependent on the extent to which the populations that developed these traits contributed to the emergence of H. *sapiens*. James and Petraglia (96) have reviewed the evolution of modern humans in South Asia, which we shall summarize a little later. Likewise, recent comparison of Eurasian Palaeolithic burial practices revealed more or less continuous, gradual change through the Late Pleistocene that culminated in recognizable modern behavior by the Last Glacial Maximum.

The Later Pleistocene time frame (i.e., the period spanning ca. 250,000 to 10,000 years ago) has come under increasing scrutiny for identifying the origin and spread of modern humans. Genetic research on modern human populations, the analysis of ancient DNA, and fossil evidence indicate the origin of *Homo sapiens* in Africa by ca. 195,000– 150,000 years ago (see Chapter II.4.). Archaeological evidence in Africa indicates that the first manifestation of modern human behavior occurs in the Later Pleistocene (16). However, debate continues concerning whether behavioral modernity slowly developed over a long period of time or appeared as a complete cultural package after 50,000 years ago.

A Revolution that was Not: The above picture specifically pertains to Europe; other parts of Eurasia are generally devoid of a discrete period in which we can detect the sudden emergence of modern behavior. Some authors have started to question the assumption that the emergence of the 'modern' man is somehow connected with the onset of the symbolic behavior of humans even in Europe. In their opinion, there was no pan-European 'explosion' in explicitly symbolic behavior at the beginning of the Upper Palaeolithic. In Italy, for example, modern human behavior appeared in a piecemeal fashion. Standardized blade production, increased tool complexity, the first burials, and the

widespread occurrence of art and personal ornaments occurred in the Mid Upper Paleolithic, at around 25,000 years ago, long after the first appearance of anatomically modern humans. Increased population density, regional diversification of stone tool industries, and the widespread occurrence of structured living spaces did not occur until the Late Upper Paleolithic, after 16,000 years ago. All this adds up to the growing proposition that the behavioral changes are not closely correlated with the Middle–Upper Paleolithic boundary.

The proponents of the ‘human revolution’ model claim that modern human behaviors arose suddenly, and nearly simultaneously, throughout the Old World *ca.* 40,000–50,000 years ago. This fundamental behavioral shift is purported to signal a cognitive advance, a possible reorganization of the brain, and the origin of language. Because the earliest modern human fossils are found in Africa and the adjacent region of the Levant at more than 100 years ago, the human revolution model creates a time lag between the appearance of anatomical modernity and perceived behavioral modernity, and creates the impression that the earliest modern Africans were behaviorally primitive. But, many of the components of the “human revolution” claimed to appear at 40,000–50,000 years ago are found in the African Middle Stone Age tens of thousands of years earlier. These features include blade and microlithic graphic aquatic resources, long distance trade, systematic processing and use of pigment, art and decoration. These items do not occur suddenly together as predicted by the “human revolution” model, but at sites that are widely separated in space and time. This suggests a gradual assembling of the package of modern human behaviors in Africa, and its later export to other regions of the Old World.

Workers such as Lahr and Foley (97) and McBrearty and Brooks (95) have argued that previous views of modern behavioral origins are fatally flawed. McBearty and Brooks in their extensive treatment convincingly show that the widely accepted viewpoint display a Eurocentric bias and a failure to appreciate the depth and breadth of an African Middle Stone Age record that precedes the supposed ‘Human Revolution’ by at least 100,000 years. In this view, modern feature, such as advanced technologies, increased geographic range, specialized hunting, aquatic resource exploitation, long distance trade and the symbolic use of pigments, occur across a broad spectrum of Middle Stone Age industries. This suggests a gradual assembly of the package of modern human behaviors in Africa during the late Middle Pleistocene, and its later export to the rest of the World. Thus the origins of our species, behaviorally and morphologically, was linked with the appearance of Middle Stone Age technology, dated in many parts of Africa to more than 250,000 years ago.

McBearty and Brooks argue that models derived from the unique record of European prehistory do not explain events in Africa where the origin of modern humans actually occurred. In the Holocene, western Europe experienced a series of incursions from the peripheral portions of the Old World. Each arrival of a wave of invaders and alien technology induced a fairly sudden, rapid cultural turnover. These disruptive episodes are reflected in the European archaeological record as discontinuities that punctuate industrial periods of relatively long duration. They have been sometimes de

the ‘‘neolithic scribed as ‘‘revolutions,’’ such as revolution’’ of Childe

Recent paleoclimatic data chronologies have supported the early suggestion of Howell (98) that regions of Pleistocene Europe were repeatedly isolated by ice and mountain barriers, so that its hominin populations were periodically reduced or even eliminated. Thus, the ‘‘revolutionary’’ nature

of the European Upper Paleolithic is most probably due to discontinuity in the archaeological record rather than to the sort of rapid cultural, cognitive, and/or biological transformation that technology, bone tools, increased georange, specialized hunting, the use of

and refined has been argued by proponents of the ‘‘human revolution.’’.

How might the archaeological signature of continuous evolutionary change be expected to differ from that of abrupt replacement? If the entire human species experienced a simultaneous, punctuated, genetically encoded event, such as the development of modern capacities for language, one would expect the transition to modern human behavior to be abrupt, in Africa as well as in Europe and Asia. On the other hand, if aspects of modern human culture in Africa were developed by hominins using existing cognitive capabilities and transmitted by cultural rather than by genetic processes, the most likely scenario would be an accretionary process, a gradual accumulation of modern behaviors in the African archaeological record. This change need not be unidirectional or confined to a single location. Rather, we might expect innovative behaviors to appear at different times and in different regions, and due to low population densities we might expect the transmission of new ideas to be sporadic.

Upper Paleolithic Industries in Pakistan: As far as the evidence from Pakistan, or from South Asia generally, is concerned, we do not have such a crisp picture here to look at as we see in Europe. On one account, there is no obvious sign of the ‘arrival’ of modern man before or after the European date of around 40,000 years ago. In fact, if there is some marked change in lithic technology to be observed, it is around 70,000-80,000 years ago. On another account, an unbroken sequence of stone artifacts and the development of one lithic tradition out of the other indicate a continuity of human presence in this part of the world without any detectable break. There is some accelerated change in the technology of tool making but this change is rather subtle and gradual. Nevertheless, archaeologists continue to look for the tell-tale lithic technologies and the type-artifacts, such as blades and burins, and hitch their wagon to the European horse. Not surprisingly, they do find some stone tools here and there which can be shown as parallel development to those found in Europe and West Asia. Since Europe is much more extensively studied, it provides them with a ready reference and a convenient context for describing their own finds.

In general, the Upper Paleolithic or the Later Stone Age is a weakly expressed cultural stage in the subcontinent, so much so that one could wonder if this is really a cultural period there at all. Nevertheless, we do observe in parts of Pakistan and parts of India some aspects of familiar traits of the Upper Paleolithic which these regions share with other regions of the world while maintaining their own adaptive features and material culture developments that need to be studied in their own right.

Not all of the tool types and implements that are the hallmark of the European Upper Paleolithic are evident in the Upper Paleolithic record of Pakistan, and for that mater, that of India and Afghanistan. There is also no revolutionary and rapid technological changes in lithic industries in this area. Thus, if we define the Upper Paleolithic in terms of stone tools and the methods of making them, we do not see any Upper Paleolithic phase in South Asia. It is another matter if there are some other tell-tale signs in lithic technologies that connect this region to the broader world in the West.

Archaeological evidence in Pakistan shows the beginning of the appearance of blades and burin industries in the Middle Stone Age all over the region but they become much more widespread in the

Later Stone Age at some places. The regions of Pakistan, which offer a generous lithic record of this type, are the Lower Indus Valley, Peshawar Valley, and to a lesser extent Pothwar. In addition to blades and burins, scrapers, backed knives, and points abound in these sites but burins are rather rare except in the Peshawar Valley where Sanghao Caves are located. Two-sided leaf-shaped points are common in some Upper Paleolithic industries of the West but not in Pakistan or the borderlands. Scrapers of several different types, however, are particularly in evidence all over the country. In this connection, the Upper Paleolithic industry of Sindh, Las Bela, and Murri-Bugti areas especially stand out for their magnificent long blades struck from standardized prismatic cores of chert.

The Upper Paleolithic industry in southernPakistan distinguishes itself from that of India where the blade industry is only marginally observable and that too only at a few selected sites. It also differentiates itself from that of Central Asia. Blade-making makes its appearance in the Pothwar region in late Middle Stone Age and continued to be developed and refined during the later phases of the Stone Age. Blades and burins were used up to and beyond the beginning of the Iron Age in *ca.* 1000 B.C. A large number of 'factory sites' around Rohri and Hyderabad is a witness to this observation. The Levallois techniques were common in Pothwar and the Peshawar Valley in the Middle Stone Age but they were not unknown in Sindh either. These continued to be used in the Upper Paleolithic in the North (especially in Sanghao Caves) as well as in the South.

Since the commonly acknowledged Upper Paleolithic industries are so diffused in the archaeological record of Pakistan, along with Afghanistan and India, the Later Stone Age of this region is still being defined and this is being done on the strength of its own characteristic artifacts rather than on the basis of blades and burins. And, since, there is no Upper Paleolithic "Revolution" in evidence in any part of this region. The chronological outline, defining the transition from the Middle to the Upper Paleolithic is even more problematic. All this boils down to a fuzzy description of the Upper Paleolithic sites and the lithic industries found at these locations.In spite of these reservations, we attempt a brief review in the followings.

According to the "classical" view, blade and burin technology in South Asia is classified as Upper Palaeolithic, with the implicit assumption that it is derived from the culture arising first in the Near East and expanding approximately 40,000 years ago toward Europe and eastward to South and Southeast Asia. James and Petraglia (96), however, argue on the basis of the wide diversity of Late Pleistocene lithic tools in South Asia, the continuity of Middle and Upper Palaeolithic sites, and their distinctiveness from the contemporary artifacts of the Near East and Europe, that the South Asian "Upper Paleolithic" developed largely from local roots. This suggestion contests the view that the origin of modern humans and their global spread were based on a dramatic shift in human behavior toward modernity recognizable through a package involving symbolic art, long-range exchange networks, and standardized technologies. Such a package, in theory (99), would provide a reasonable explanation for the success of modern human expansion from the northeast corner of Africa through the Near East to replace the world's preexisting hominin populations. What does not fit this model, however, is the evidence of the restricted occurrence of this cultural package. Late Pleistocene sites in Asia and Australia associated with anatomically modern humans have produced mostly Middle Palaeolithic artifacts. James and Petraglia (96) explain the appearance and success of the Upper Paleolithic cultural package in the Near East in terms of demographic factors. Once the behavioral implications of the package have been neutralized, however, what cultural evidence is left to support the Northeast African exit route for modern humans in Eurasia? What remains confusing about James and Petraglia's synthesis is the discussion in support of multiple dispersals, where they note that the

genetic evidence is consistent with but does not directly support the idea of a southern route of dispersal into South Asia. While genetic dating has its challenges, the phylogeographic evidence from mitochondrial DNA and Y-chromosome studies provides support for a single southern route (82,83,88,90). Another Late Pleistocene dispersal, likely via the Northeast African exit route, would be supported by the evidence of particular Y-chromosome lineages, but this clearly refers to a much later period. Thus, as far as the genetic data are concerned, there is indeed support for multiple Late Pleistocene dispersals from Africa but only a single route for the initial expansion of modern humans outside Africa.

James and Petraglia (96) summarize the evidence for a gradual evolution of lithic technologies in South Asia from prepared-core toward the Upper Palaeolithic. Preparedcore technology has been found not only in association with modern humans but also in sites dated to more than 100,000–200,000 years ago that are associated with archaic human populations. Therefore, as they note, this technology does not allow us to distinguish between anatomically modern and nonmodern populations. Thus the discussion of the possibility that the large
landmass of the Indian subcontinent may have
been the reason the replacement event took longer
in South Asia becomes a circular return to the
model in which the Upper Palaeolithic package de
fines who is modern and who is not. Would it be
implausible, then, given the cultural similarity of dif



A few superb examples of flint blades

ferent hominin populations in the Late Pleistocene and their ordinary potential to become “modern,” that the initial dispersal from Africa along the south ern route carried predominantly the same prepared core technology with some elements of the Upper Palaeolithic package that rather quickly, by cultural adaptation or drift, became dominant in the West while the South Asian populations had more time to channel their cultural richness toward one main stream technology?

Climatic Imperatives of the Upper Paleo

lithic: The changes in stone tools and in methods of making them which characterize the Upper Pa leolithic coincide with the last phases of the Pleisto cene, when the last glaciations was coming to an end and sea levels were at their lowest. A lot of at mospheric moisture was sucked up by the ice sheet, the air was dry, and rains were meager.Thus, just as the Middle Paleolithic is a manifestation of a relatively humid period in Pakistan, so is the Upper Paleolithic a reflection of the dry spell that followed. Deserts tended to expand, new sand-dunes were formed and old ones rejuvenated, and the dust and sand blown off arid areas were deposited in many regions. The arid conditions may have exceeded in intensity as compared to those prevailing today in this desert belt. This has been confirmed by analysis of fossil sand dunes, eustatic and sedimentary data, and ocean core studies of borings taken off the coast of Pakistan. All this must have involved progressive change: the Thar which had been a savannah region during Middle Paleolithic time, reverted to desert regions. The marshland and thick forest in the Indus delta changed to grass and open woodland, and larger trees retreated to river valleys and the margins of major rivers. Grazing animals must have moved with the environments that suited them into new regions of the plains and the hills, and communities of hunter-gatherers must have done the same.

Changes in the stone tool assemblage probably reflect adaptations of groups of huntergatherers to this changing environment. Drier conditions would probably have meant a greater dependence upon meat, as opposed to vegetable foods, and must have called for movement of humans over longer distances. It is under these circumstances that the Upper Paleolithic tools industries developed in Sindh and elsewhere in Pakistan. Certain limited localities, especially those inhabiting around lakeshores, however, had comparative advantage and these appear to represent a continuous local cultural and technological tradition. Some of this cultural change is indicated in the research conducted by Paulo Biagi during more than a decade in the Lower Indus Valley (43,44,59,87)

Formation of extensive sand sheets and sand dunes took place throughout the Dry Zone of Sindh and Baluchistan. Well-dated geomorphic data suggests that the vegetation cover over most of the area thinned out. The Thar Desert between Pakistan and India expanded and only the areas on its margins, such as that between the Indus and the Hakra rivers, (see the map) remained hospitable to some extent. Because of this extremely arid climate and the resulting sparse vegetation and animal life, human populations were faced with restricted food resources. This is confirmed by the limited number of upper Paleolithic sites in the arid and semi-arid regions in Pakistan as well as in India.

Corresponding climatic long-range changes probably also took place in the north of Pakistan where the presence of man in the previous phase, the Middle Paleolithic, was rather strong. Thus, the onset of the Upper Paleolithic ushered man to a difficult period of human existence. According to one theory, it was this adverse climate that spurred man to think innovatively and forced him to devise novel means for coping with the environment and these compulsions of survival quickened the technological and material progress of human race.

Upper Paleolithic Sites in Pakistan: Since archaeologists usually define the Upper Paleolithic industries of South Asia in terms of Europe, the artifacts of the period, when they are found, invariably come closer to their western counterparts in respect of both form and technique. All, inevitably, also have certain regional characteristics. Evidently, this is a case of self-fulfilling prophecy and a classical example of circular argument. Nevertheless, this line of evidence, circular or not, has given rise to defining the Later Stone Age of Pakistan in terms of blades, which are frequently found in the Lower Indus Valley but also in the North. The following review of the presumed Upper Paleolithic sites is along tsuch a line of evidence. Lower Indus Valley, which roughly corresponds with the province of Sindh and the southeastern part of Baluchistan, figures prominently in this description. In the North, the Pothwar Plateau recedes in archaeological background but the Peshawar Valley, as represented by Sanghao Caves come in a renewed focus.



Two bullet cores from which very narrow bladelets have been removed, and which were then discarded at Rohri Hills

The Lower Indus Valley: The lower Indus Valley probably represents most faithfully the Upper Paleolithic in terms of the lithic industries as defined through the European idiom. *It is largely based* based on the production of parallel-sided blades made from prepared unidirectional cores. Middle Paleolithic techniques of core and flake production are not lost, but continue alongside the new methods, on a reduced scale both numerically and in terms of average size. Burins are, however, not many. Most of the sites lie at the outer margins of the Thar Desert which has been contracting and expanding in expanse ion response to prolonged wet and dry spells. Studies of Bridget Allchin and associates have brought this factor in focus (45). Paolo Biagi is credited for his detailed work during a full decade of extensive research in Sind, especially at Rohri Hills and the Milestone 101 near Hyderabad. Here Upper Paleolithic tools first occur at the end of the wet phase associated with Middle Paleolithic industries, then continue as these regions become drier between 30,000 and 10,000 years ago.

In a short preliminary survey of Rohri Hills, Allchin and associates found limited evidence for the existence of Upper Paleolithic (defined in terms of blades and burins) in this area but it seemed highly probable to them that “a more thorough survey would bring to light further Upper Paleolithic working areas.” This expectation, in fact, materialized when Biagi and coworkers began their

research work there some twenty years after.

As it turned out, the vast expanses of chert in the Rohri hills in Upper Sindh and at Ongar in Lower Sind were extensively exploited in the Upper Paleolithic. Hundreds of these sites give us a fair idea about the typology and the form of the Upper Paleolithic stone industry in Pakistan. The material available is immense. It not only comprises of the actual tools but also manifold quantities of debris. Several cores have been found from which blade tools had been extracted. Many half-prepared chert pieces found on the surface of these factories give us the idea about the technology of making blade tools in the Upper Paleolithic times. The number of sites is staggering; more than 2,000 sites have been mapped. There can be little doubt that factory sites based on sources of good quality chert or quartzite covered a wide area; but just how wide, is a matter of oblivion as most of these sites have been mercilessly destroyed for supplying limestone to the nearby cement factories.

Allchin's important find from Chancha Baluch, Nawab Punjabi and a working floor at Rohri Hills: "we found one which appeared to have been used entirely to make parallel sided blades of Upper Paleolithic type…. These were distinct from Harappan blades, being altogether thicker and less regular in outline and having much larger bulbs of percussion, indicating a different technique of striking off the core, probably by a direct blow with a stone hammer…. This one working floor, R5c, was the only decisive evidence of an independent Upper Paleolithic presence" (45).

The most clearly differentiated Paleolithic site of Chancha Baluch that Allchin describes in details in her later writings, was at the southern end of the Hills near the village of Chancha Baluch, and only four kilometers from the pre-Harappan and Harappan settlement of Kot Diji. "Spread out over an area about 100 meters by 50 meters, on a largely sand-free area between dunes, are Middle and Upper Paleolithic artifacts and factory debris. A classified list of the collection shows that Middle Paleolithic artifacts - flake cores of various types, pointed flakes, hand axes and flakes from prepared or previously struck cores - predominate, together making up 65 percent of the artifact collection**.** Characteristic Upper Paleolithic artifacts, blade cores and blades, make up 22 per cent of the collection." (31)

"In the same locality as Kot Diji and Chancha Baluch, local villagers showed us another flat topped hill, close to a hamlet known as Nawab Panjabi, on which there was an extensive series of working floors. All the chert was of the darker kind similar to that used by Middle and Upper Paleolithic craftsmen at the northern end of the Rohri Hills. An analysis of these shows that there is a certain amount of Middle Paleolithic material on the site but a blade industry with its by-products appears to predominate. The working floors are not so clearly isolated as at the northern sites, and no comparable attempt appears to have been made by the blade makers to clear away earlier material; they seem rather to have worked on top of it, sometimes even reusing older cores. The proximity of the small preHarappan and Harappan urban site of Kot Diji suggests that the blade makers of Nawab Panjabi may have been its pre-Harappan inhabitants." (31).

These observations make it clear that the Harappans, in using the Rohri Hills as a source of raw material and a factory area for producing large quantities of stone blades, were continuing a much older tradition, extending back to Middle Paleolithic times. The size of these factory areas suggests that they were supplying artifacts or partially worked chert cores to a region extending far beyond the confines of the hills.

Pothwar: At present no true Upper Paleolithic sites, as understood in Europe, are known in Pothwar

(6,28) except one (described below) but there are general indications of late Upper Paleolithic in the shape of a variety of scrapers and blades which are generally smaller than those found in the lower Indus Valley. These have been described in the Soan Valley by de Terra and Paterson in 1930s, by Dennell and Rendell in 1980s, and Salim in 1990s. A large number of artifacts, consisting of flake-blade elements were collected by these researchers and from various sites. These artifacts seem to belong to a terminal Pleistocene period, bridging the gap between the Middle Paleolithic and Mesolithic. Blades and bladelets are present but

Fig. 1. Itinerary and principal sites visited by the expedition

of the Indus and its western tributaries such as the Bolan and other rivers. Today the water is distributed by means of extensive irrigation systems, but in the past the Indus has watered its plains by inundation in a manner comparable to the Nile.

The same factors, silt deposition and flooding, that make the plain so productive render the lower Indus a highly unstable river inclined to build up its channel and change its course frequently. There is ample historical, geographical and archaeological evidence to show that this has happened repeatedly during historic and later prehistoric times, and it has been ably discussed in all its aspects in the pages of this journal and elsewhere by Lambrick (1964, 1967 and 1973) and Holmes

Hammer stones continue to be found on working floors, as in the Middle Paleolithic. The artifacts of earlier Paleolithic industries show bulbs of percussion as pronounced as those of the Middle Paleolithic, but as time goes on the technique of making parallel-sided blades is continually refined, the bulbs of percussion become less predominant, and the blades more slender, straight and regular. Besides the tell-tale artifacts assigned to the Upper Paleolithic, de Terra and Paterson studied a collection of Pothwar-specific Soan artifacts from a terrace near Dhok Pathan which they labeled a localized industry towards the end of the Pleistocene. Movius later named it the *Evolved Soan*. The site of Pindi Gheb is another site that belongs to this terminal stage. Salim also made several collections of Soan artifacts of this age in Pothwar in 1974 (6). The Evolved Soan seems to belong to the Fourth Glacial Age and some researchers have placed them squarely in the Later Paleolithic, i.e. the Upper Paleolithic. Evolved Soanian artifacts, like those belonging to the Early and Late Soan traditions, were primarily manufactured on quartzite pebbles, cobbles, and occasionally on boulders. The assemblages generally comprise varieties of choppers, discoids, scrapers, cores, and numerous flake types, all occur

Palaeolithic Sites in the Plains of Sind and Their Geographical Implications (110).

they are not in sufficient number as to warrant the use of Upper Paleolithic terminology in the widely accepted sense.

Burins become a rather more prominent feature, and are increasingly made from milky, par tially crystalline quartz where this is available. Whether made of quartz or other materials, they tend to be of the South Asian kind noted at Sang hao and elsewhere. The majority are simple angle burins, the burin edge made by the removal of a single flake by means of a carefully controlled blow, using as a striking platform a facet provided by the natural tendency of quartz to fracture into rectangu lar pieces. Alternatively, the broken edge of a flake or blade, or any other available piece of quartzite or other raw material of suitable thickness was some times used. Scrapers of various kinds, including carinated scrapers, continue to be made from both flakes and blades, but are not such a major part of the assemblage as in Middle Paleolithic industries.

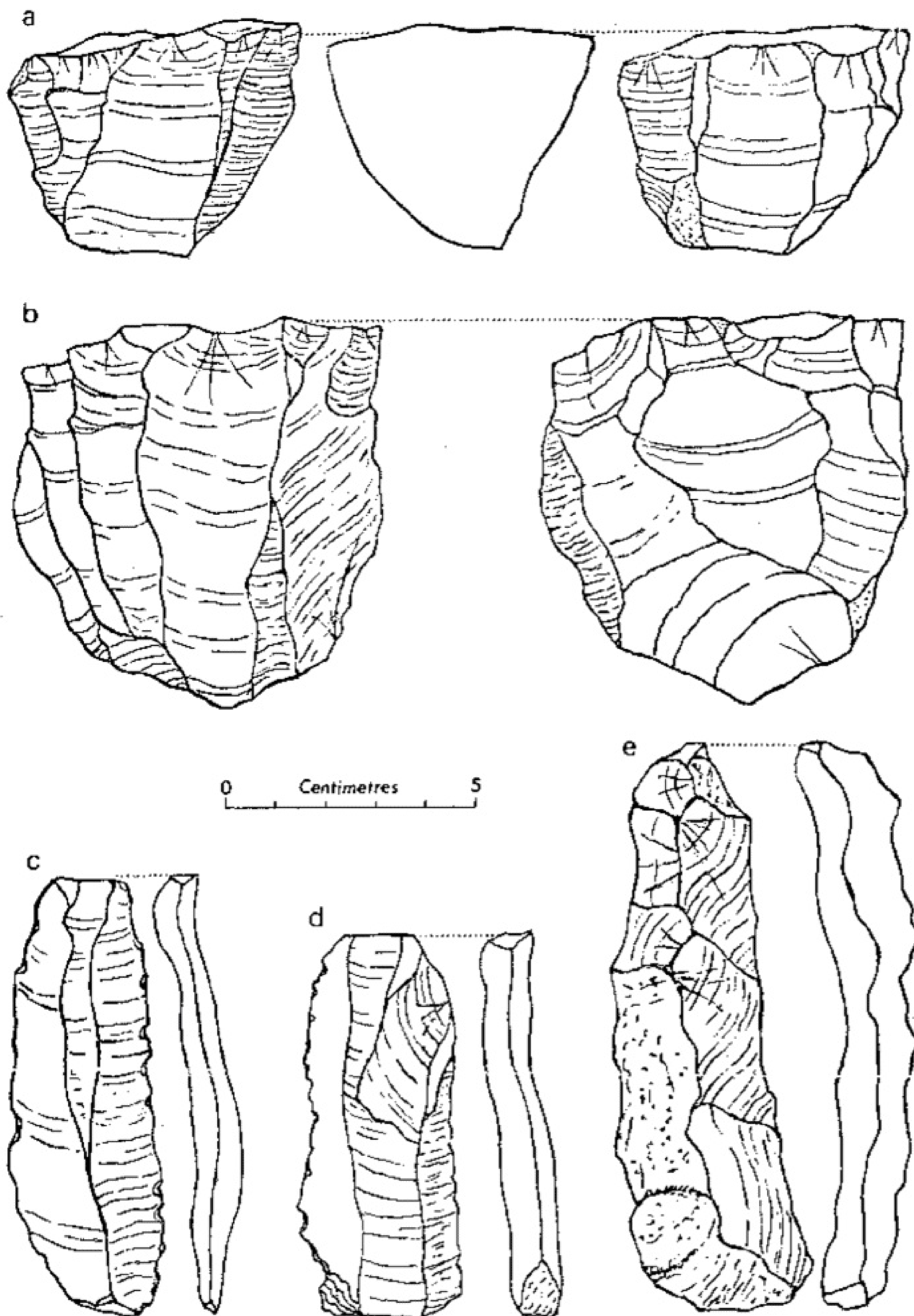


Fig. 4. Artefacts from an Upper Palaeolithic working floor in the Rohri Hills : a and b, blade cores ; c and d, blades ; e, blade core trimming flake

Artifacts from an Upper Paleolithic working floor in the Rohri Hills: a and b, blade cores; c and, blades; e, blade core trimming flake

the earliest dates for an Upper Paleolithic tool assemblage. How the Riwat material relates to the Upper Paleolithic of southern Pakistan and the subcontinent as a whole remains to be seen. Both from a technological point of view and from its early date it can best be regarded as transitional from Middle to Upper Paleolithic. The excavations of the geological formations from the third interglacial period, have uncovered the teeth of a dog along with the stone tools of the Upper Paleolithic. This may be taken as evidence that dog was already a domesticated animal. There are also reports, although unconfirmed, of the findings of bone fragments of camel, ox, and buffalo. Whether these animals had been domesticated at that early times, cannot be said.
Sanghao Caves: The excavation of Sanghao caves and the

Location and geological setting of Site 55 in Pothwar (20)

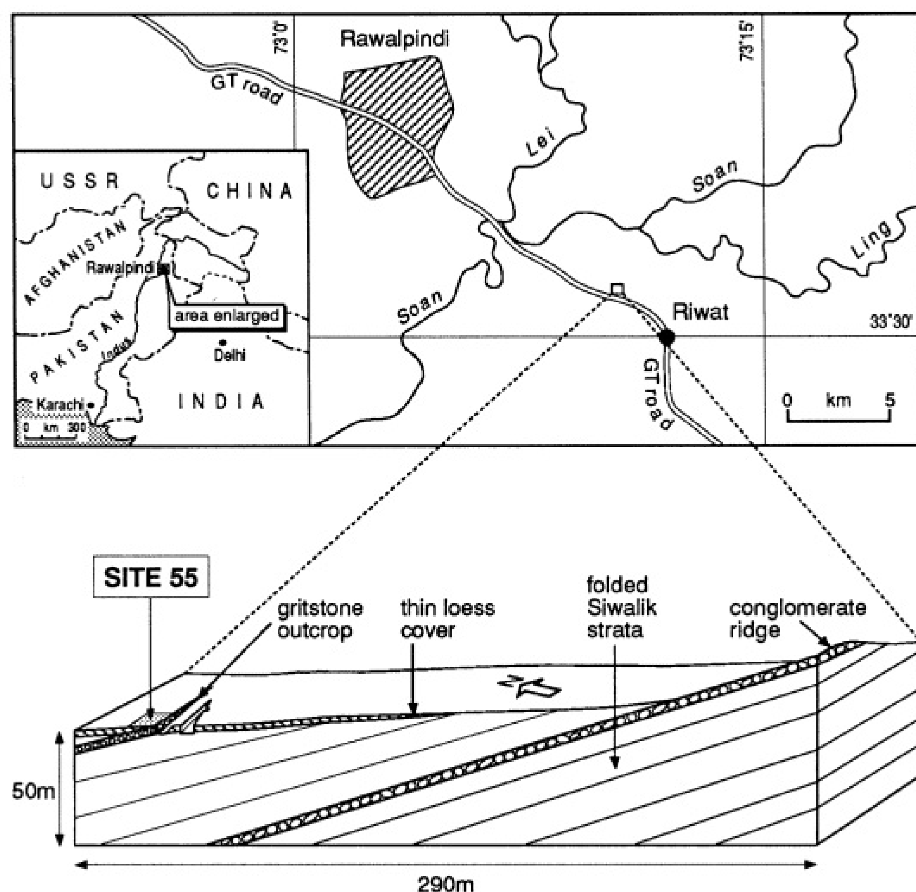


Figure 1. The location and geological setting of Site 55.

conjoining flakes and blades was found the following year in a small gully section nearby. These finds led to a small-scale excavation of the loess behind the outcrop in the spring of 1981, and this resulted in the discovery of traces of a stone structure and an associated blade and flake assemblage. Further excavation in the spring and autumn of 1982 eventually resulted in the exposure of a ca. 225 sq-m area.

The Excavation

Excavation techniques had to accommodate various local problems. The workforce comprised Afghan refugees, who were entirely unfamiliar with excavation techniques. These had to be supervised single-handed for most of the time, or even by two archaeologists. The weather was often a problem during the excavation. When first exposed, the loess was a delight to excavate, displaying subtleties of texture and color. After an hour or so on dry, hot days, it became hardened and bleached, but color and texture could be regained by gentle use of a hand-spray; often, however, the surface puddled instead. In contrast, the site often flooded after heavy rains. An additional problem was that much of the flaked stone assemblage lay on a conglomerate stone surface, much of which had been flaked naturally or deliberately. Recording with drawing frames (and while supervising an unskilled workforce) was clearly impracticable. In the final, 10-week excavation, a specially designed photographic frame was used with which a 2-m square could be recorded with four photographs. Once taken, these photographs were enlarged, pieced together, and overlain with transparent paper on which details of each stone could be plotted.

The Dating of Site 55

The TL dating of Site 55 posed a range of problems in sampling, analysis, and interpretation, and the primary results of this work have already been presented (Rendell and Dennell 1987). The loess cover was relatively thin (<2m), and although this was advantageous as far as the

ring in varying typo-technological frequencies at individual sites.

The archeological site 55 near Riwat is of particular interest in the study of the Upper Paleo lithic in South Asia as this is the earliest *dated* Up per Paleolithic site we know of in South Asia (4,20). This is an open air site and it features the produc tion of large parallel-sided blades. Loess had been accumulating at the time the site was abandoned, and later covered it completely, protecting it from disturbance and providing a means of dating. The excavators carefully removed the loess and made a detailed study of the site, plotting every feature, in cluding each piece of stone. They showed it to be a single period site where, they think, hides were cured in the shelter of a windbreak. Stone tools were made for use at the site and perhaps also to be carried away. The stone used was quartzite, and the blades large and thick when compared to those from some other Upper Paleolithic sites from Poth war and Sanghao Cave, were produced. This site has been dated by the thermoluminescent dating of the overlying loess to *ca*. 45,000 years ago or ear lier (meaning that it was occupied at that time or marginally earlier or later). This is well before the height of the last glaciations which is considered to

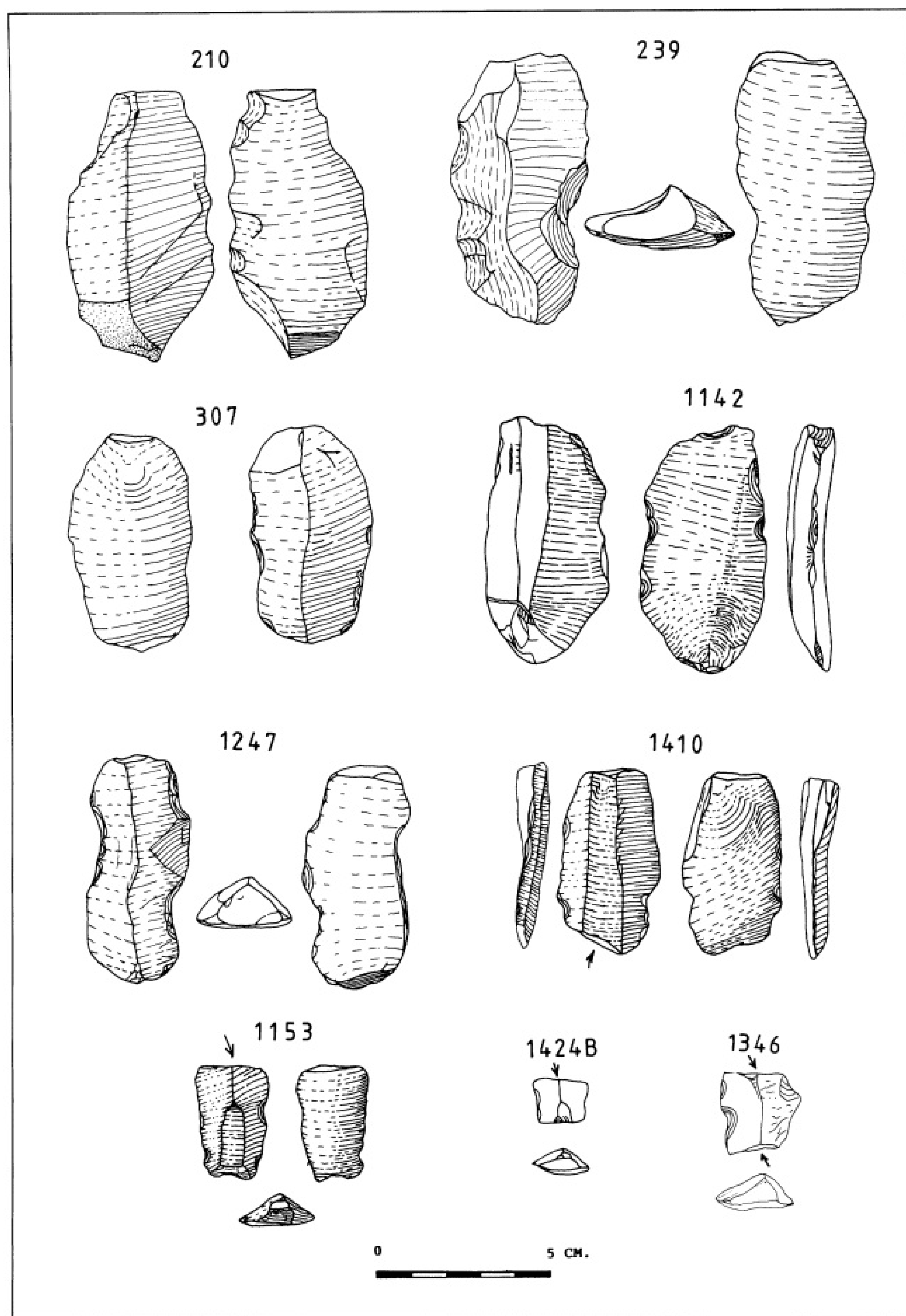


Figure 9. Some blades and bladelets from Site 55.

the importance of excavating as large an area as possible, as otherwise the assemblage might have been mistakenly seen as flake- or blade-dominated, depending on which part of the site had been excavated. The concentration of blades near the structural features may imply, first, that this was the main activity area and, second, that many of the flakes may have been waste byproducts of making blades. The distribution of conjoining pieces (FIG. 11) is consistent with these inferences. Both flakes and blades were produced from the same cobble, and the distribution

be *ca.* 18,000 years ago, let alone the following pe**Some blades and bladelets from Site 55 in Pothwar (20)** riod of arid conditions. In global terms, it is among
surveys of the vicinities in the Mardan District have revealed tools from Upper Paleolithic period. Another cave of Sanghao type has recently been discovered at Tango Nao, near Nawagai in the Bajaur Agency in K-P province. It is 21 meters long, 14 meters wide and three meters high and is said to be contemporary with Sanghao cave discovered earlier in Mardan District in 1962. Nothing has yet been published about this discovery but anecdotal reports put this habitation cave in the Upper Paleolithic.

Sanghao cave has a deep occupation deposit, which have been described in some details in the previous chapter of this book. Besides an array of the Middle Paleolithic artifacts, excavations have yielded Upper Paleolithic tools of milky quartz, some of them have been dated. Dani and coworkers found an occupation deposit at least three meters deep and debris characteristic of both the Middle and Upper Paleolithic traditions. Hearths and numerous animal bones and what appeared to be burials could be seen in the sides of the excavation trenches, but, sadly, everything excavated, with the exception of a few small pieces of stone, had been discarded and no records kept. The discarded artifacts and debris (almost all milky quartz) showed some affinities with the Middle and Upper Paleolithic industries of those from sites across the mountains in Afghanistan.

Baluchistan: Surprisingly, no artifacts of the Upper Paleolithic age have been discovered in Baluchistan. Since we see the Indus man first emerging into an agricultural society in that part of the country several millennia later, the absence of the Upper Paleolithic man in Baluchistan is all the more surprising. This is most likely for the reason that not enough research work has been done regarding the Paleolithic of Baluchistan.

Western Sind was one of several preferred habitats in the early Holocene when the Upper Paleolithic hunters sought lakes, river banks, and natural springs. Such ecosystems were also available in eastern Baluchistan and it is presumed that this area was definitely the home of the Upper Paleolithic peoples as the western Sind was at the time. These desirable habitats continued to be occupied by Mesolithic people after 9000 B.P. when the present less arid conditions began.

The Borderlands: The Upper Paleolithic sites are quite few in India and their distribution appears to be more limited than that of the preceding Lower and Middle Paleolithic, or of the Mesolithic that followed. This is no doubt partly due to the general increase in aridity, and partly because we have as yet only a few independent dates for the period as a whole, and often do not know which other stone industries are contemporary with the distinctive Upper Paleolithic blade industries.

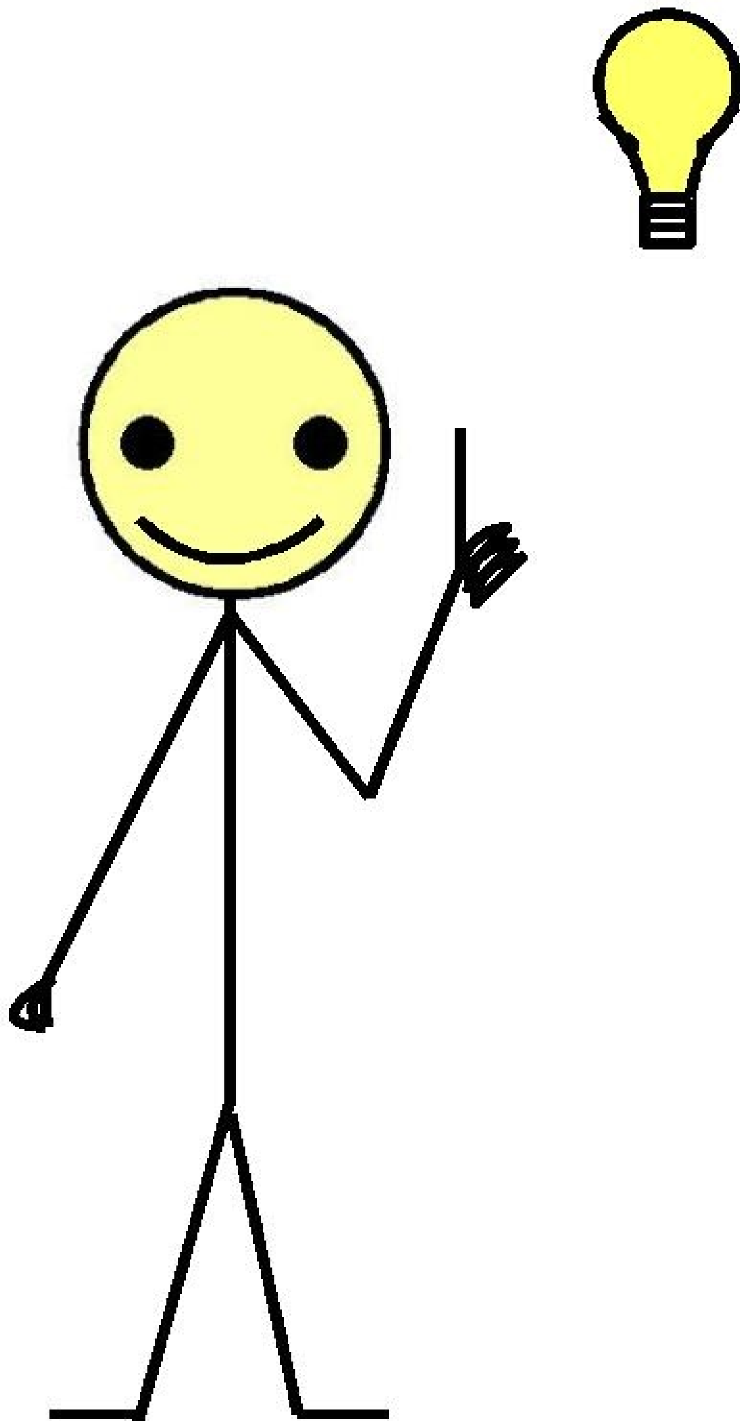
Several Afghan caves, both north and south of the Hindu Kush, were excavated during the 1950s and 60s. They were found to contain stone industries of both Middle and Upper Paleolithic character, of somewhat confused stratigraphy, followed by the Upper Paleolithic and finally microlith material. The artifacts were made chiefly of goodquality local flint, there were also large surface factory sites. A number of Carbon-14 dates were obtained from various levels in some of the caves which give a range *ca.* 32,000 to *ca.* 10,000 years ago for the whole complex. At one of them, Aq Kupruk, in north Afghanistan, animal bones stratified with Upper Paleolithic artifacts were found to be almost exclusively those of sheep and goats which formed 90 per cent of the total. The remaining 10 per cent included bones of gazelle, aurochs, onager or wild ass, red deer and wolf. This was taken to indicate that sheep and goats formed a regular part of the diet of the occupants of the cave, while the other

species were hunted.

The Upper Paleolithic and the Diversity of Stone tools: Like in Europe, the Upper Paleolithic in Pakistan is marked by changes and developments in the character of the stone artifact assemblage, based upon a general reduction in the size and weight of artifacts, and by new methods of stone-working closely comparable to those taking place in Europe and western Asia but not imitating it in details. Since there was no pressing need, there were probably no bone needles and awls, for example. And since human abstract thought can be expressed in so many ways, the absence of rock art in this region should not be taken as the absence of abstract thought in the Later Stone Age of South Asia. Nevertheless, it is not completely absent as the later stages of the South Asian Upper Paleolithic are associated with the beginning of the distinctive rock art of Central India and that in Kirthar Hills in Sindh as well as the rocks of Chilas in the northern part of Pakistan.

Blades alone, however, do not define the Upper Paleolithic of Pakistan; probably more important are the scrapers and bladelets, which are found in a large variety both in the North as well as in the South. Some of these were probably hafted and served the same function as the blades. All in all, it is the increased proportion of sharp edge per unit of the raw material and the light weight of the tools which we should look for in the South Asian Upper Paleolithic. Regionalism seems to be the order of the day as the tools of each region show quite a bit of individuality. The tool-making techniques show somewhat more sophistication all over Pakistan and the tool size is considerably diminished. The use of handaxes and flake scrapers, a hallmark of the Middle Paleolithic, seems to continue into the Upper Paleolithic, along with the newly crafted parallel sided blades, bladelets, burins, and light weight scrapers.

The change described in the basic tool-kit does not appear to have been a complete or sudden one. Often where the new blade technology appeared the older methods of preparing flake cores of various kinds continued alongside it in a reduced or miniature form. The extent to which the new technology took over varied from region to re



gion, and in some it had little impact beyond a reduction in size.

In view of all this diversity we must assume that, in the widely varying environments of Pakistan, different life-styles coexisted side by side, much as they do today. As we begin to see the past in sharper focus, from Upper Paleolithic times onward, diversity emerges as a distinct element of Pakistan's Stone Age culture. The picture is clearly a complicated one, more so because some research has been done in certain areas and none in others, and we still have not got enough information to allow a general overview, or even a comparison between the North and the South. We have, therefore, concentrated on certain interesting sites and localities which to some degree give us a feeling of the nature of the new cultural developments and of the dynamics of change.

Concluding Remarks: Blades and burins are the hallmark of the Upper Paleolithic in Europe and West Asia. They are also common in Sindh, Las Bela, the Peshawar Plains and the parts of the Pothwar Plateau, although less common in the North than in the South. One great advantage of blades was

their light weight; they provided straight, sharp edges with a minimum weight of stone behind them. Frequently, they were made of fine glass-like rock, such as flint or chert, which provided a razor-sharp edge. Since they would shatter so easily, they were most probably mounted on wood or bone, embedded in a strong mastic such as resin or bitumen with only the cutting edge exposed; and sometimes also by slotting them into grooves. The use of these techniques resulted in a very light and versatile tool-kit. Supplies of whole blades or selected pieces which weigh very little could be carried for long distances, if necessary far from the source of supply, and used when needed as replacements for broken or lost parts, or for assembling new knives, missile heads, etc. Extensive factory sites at Rohri Hills and Ongar in Sindh are witness to the fact that these sites served to make tools for much wider population than could have inhabited the surrounding region.

Characterization and identification of the Upper Paleolithic in Pakistan and South Asia generally is a difficult task, to say the least. The heart of the matter is an understanding and reevaluation of some of the basic concepts of South Asian archaeology in a global context, including modern human behavior, the cultural shift(s) toward it, and the geographic spread of its manifestations.

First, not many dates are available and those that are available are from single samples or from contexts that are not part of long stratigraphic profiles. Assemblages identified as Upper Paleolithic have been difficult to date on account of their contexts and the limitations of the chosen chronometric methods. Overall, there is a paucity of chronometric information, especially in comparison with other regions (e.g., Western Europe), which have thousands of available dates. Moreover, there is little confidence in some of the chronometric results, as dates have not been verified by independent methods or by robust sampling procedures.

Second, according to the “classical” view, blade technology in Pakistan and India is classified as Upper Paleolithic with the implicit assumption that it is derived from the culture arising first in the Near East and expanding approximately 40,000 years ago toward Europe. This model is not supported by the lithic industry of this region. On the basis of the wide diversity of Late Pleistocene lithic tools in South Asia, the continuity of Middle and Upper Paleolithic sites, and their distinctiveness from the contemporary artifacts of the Near East and Europe, it can be argued that the Pakistan's, and for that matter India's, Upper Paleolithic industry developed largely from local roots. This suggestion contests the view that the origin of modern humans and their global spread were based on a dramatic shift in human behavior toward modernity recognizable through a package

involving symbolic art, longrange exchange networks, and standardized technologies. Such a package, of course, is nowhere to be seen anywhere in the subcontinent. Nor does this model explain the fact that the Late Pleistocene sites in East Asia and Australia associated with anatomically modern humans have produced mostly Middle Paleolithic artifacts. This technology does not allow us to distinguish between anatomically modern and non-modern populations.

In Pakistan, the Upper Palaeolithic Industries seem to have appeared in the arid regions of Pakistan and the adjoining part of India. In site 55 at Riwat, the archaeologists found evidence of the production of large parallel-sided blades of quartzite. This site has been dated by thermo luminescent method to ca. 45,000 years ago. However this site is regarded as transitional from Middle to Upper Palaeolithic. Sangao caves in the Passhtun country are another site which provides evidence of Upper Paleolithic culture. In the Rohri hills at Milestone 101, Upper Paleolithic working areas have been identified. At Buddha Pushkar in Rajasthan some Upper Palaeolithic sites are found, which show elements of continuity between the Middle and Upper Palaeolithic sites.

Recent evidence suggests that Upper Paleolithic techniques in Pakistan as well as India developed from the Middle Paleolithic industries and became a dominant part of the stone working tradition wherever the region remained habitable during the final Pleistocene arid phase. These zones comprised of Sindh along the Indus River, pockets of the Las Bela plains in southern Baluchistan, valleys of the Pothwar Plateau and the slopes of hills surrounding the greater Peshawar Plains. These are apparently isolated areas but surprisingly the Upper Paleolithic tools of these regions share technological features which are to a large extent common. Furthermore, on all these locations a continuous local cultural and technological development of Middle and Upper Paleolithic industries is evident.

There is no clear sequence of industrial subdivisions within the Upper Paleolithic or the Later Stone Age in South Asia. There is, however, contemporaneity between flake- and blade-based technology and microlith industries after *ca.* 28,000 years ago. The microlith industries in South Asia are earlier than those seen in Europe, though they postdate the appearance of microlith technology in Africa. At the moment, however, the finds at sites such as Mulri in Sindh and the presence of microlith in other Late Paleolithic assemblages from the North suggest that at least some of these early microlith industries developed regionally rather than resulting from dispersal from elsewhere. The similarity in core reduction techniques between the Middle and Late Paleolithic industries in Sindh is intriguing. Transitional Middle to Upper Paleolithic industries have been reported at sites such as Chancha Baluch at Rohri Hills (63). This evidence suggests that at least some Upper Paleolithic industries developed from the Middle Paleolithic.

Desperate attempts are sometimes made in India and Pakistan to look for the cave art, the ornaments, the human burials, and the stone blades and all. In this quest, the technological demands on man imposed by drastically different environment is all but ignored. The result is that most of the Upper Paleolithic accounts are full of confused and clueless descriptions. This practice has distorted the contours of the Upper Paleolithic in this region and paved the way for the misinterpretation of the historic course of cultural development in Pakistan and India. India and Pakistan are not Europe, neither topographically nor climatically, and cultural developments in these two divergent regions ought to be different from those in Europe and from each other. Pakistan does not have a clear-cut Upper Paleolithic period, as defined in Europe; India does not have even that much. We are, therefore, better off to look at this phase of human history in terms of the Later Stone Age, which, of course,

includes the Upper Paleolithic wherever it does exist or is definable.

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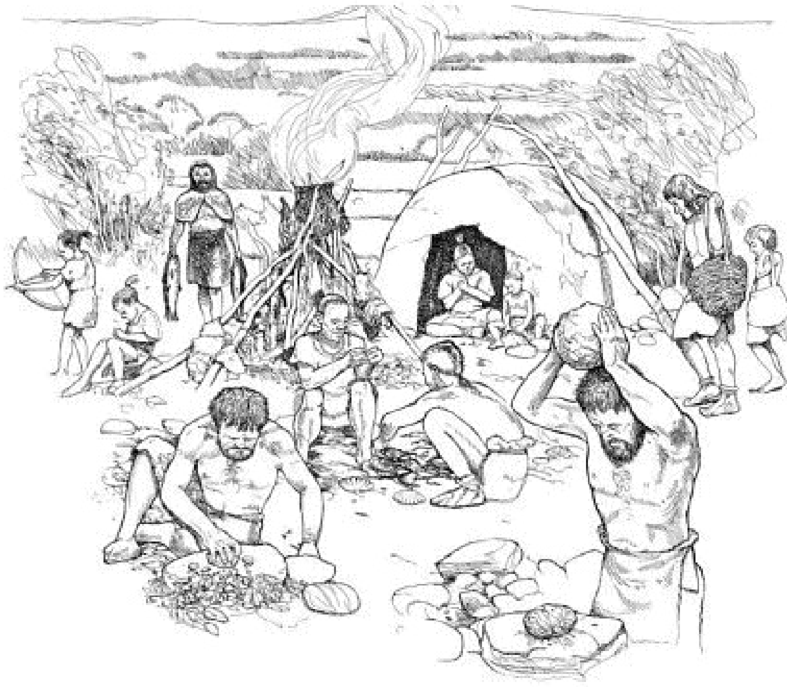
Ancient Pakistan - An Archaeological History SECTION VII



Mesolit!hic Transition

! VII.1. Post-Pleistocene Environment
VII.2. Transition to Settled Life - A Mesolithic Interlude VII.3. Mesolithic Transition in Pakistan and the Borderlands VII.4. References

VII.0. Mesolithic Transition



In the preceding Section, we left the Paleolithic Indus man making his tools in the Rohri Hills, fishing around lakes in the Lower Indus plains, hunting game on the fringes of the Thar, running after wild goats and sheep in the foothills of the Sulaimans, gathering seeds of wild barley and other grasses in the Kirthar Range, and collecting fruit and nuts in the wilderness of the Pashtun country and Pothwar. His tool kit was quite diverse, it included the straight-edge stone blades and delicately fashioned burins, along with the Acheulian handaxes, cleavers, and scrapers of various types reminiscent of the earlier times. He even did not shy away from the continued use of choppers and chopping tools of still earlier age. As the last glaciation intensified, we noticed the thinning of human population in the North and increasing settlements in the South, especially where fresh water was available all the year around, such as along the perennial rivers and fresh-water lakes. All of the region was in the grip of dry and relatively cold air, rains were scanty and the water level in the rivers was low. Lakes and water reservoirs shrank while the deserts expanded. Under these circumstances, human populations, along with wild animals, congregated around the remaining fresh water bodies in low-lying valleys and along perennial rivers, including the Indus.

When we meet him again in the 10th millennium BC, we find him settling down in small hamlets and seasonal camps all over Baluchistan and western Sindh. Here, we observe him engaged in the domestication of plants and animals that eventually lead him to agriculture and pastoralism. During the same time, we observe his tools shrinking in size and becoming much lighter. Since these miniature tools, the so-called *microliths*, could be hardly used as such, we surmise that they were assembled into *composite* tools, such as saws, sickles, spears, and stone- or bone-tipped arrows, a few examples of which we find at Mehrgarh on the border of Sindh and Baluchistan. The miniaturization of stone tools and combining them into more complex composite tools technically enhanced the chances of survival for these populations during the fast changing environment of the late Pleistocene and the early Holocene.

These tools have stylistic parallels in a vast geographical area of Africa, Europe, western Asia, and

most of South Asia. These tools are the hallmark of a post-Paleolithic tradition, the *Mesolithic*, literally translated as the *Middle Stone Age,* increasingly called the *Epi-Paleolithic.* Since our evidence for this period of human history comes entirely from archaeological sources and since these sources mainly constitute the stone artifacts, there has been a general tendency on the part of archaeologists and prehistorians alike to define this period in terms of the typology of stone tools and their manufacturing technologies. The *Mesolithic*, therefore, has become synonymous with the *microlith.* For our purpose in this book, however, we are more concerned with several other aspects of cultural developments, such as the living style and the subsistence regime, than the stone tools alone. Unfortunately, we do not have much to go on about such changes in the archaeological remains in Pakistan or other regions in the South Asian neighborhood. Our closest indications come from the Near East where much more research has been conducted in the past than that in Pakistan or South Asia in general. We shall, therefore, review these Near Eastern developments in some details to have a reference point.

The time period that has been assigned to this transformation, according to some estimates, spans between 15,000 B.C. to 7,000 B.C. Some would like to have it between 10,000 B.C. and 6,000 B.C. Still others would estimate its duration between 12,000 B.C. and 8,000 B.C. and some would even deny the existence of such a discrete transition period in context of Pakistan. This diversity of opinion largely stems from the type of evidence one values the most or one chooses to look at: some would put more emphasis on anthropological considerations while others would rely more on technological evidence. We need to sort out these arguments and come to some workable parameters for characterizing this important phase of human history and defining its temporal and special outlines.

Howsoever we define this period chronologically, we are dealing here with a momentous change in the climate. The Ice Age was coming to its end and this was changing the environment in a big way. We thus begin with a discussion on this environmental change, which was global in scope indeed. The next two chapters then touch upon the lithic technology, subsistence economy and general cultural change. This would bring us to the virtual end of the Stone Age and the beginning of the Neolithic produce animal husbanday insterad of searching for it in the wild.

The study of the transition period that connects the Upper Paleolithic to the Neolithic is important to the study of the prehistory of Pakistan. It brings the Stone Age to its close and ushers man to the dawn of civilization, that is, the Neolithic period of human culture. This Section deals with some of the technological and cultural aspects of this stage of human existence. The details of such a transition may not be clearly visible but this is what one expects in the twilight zone before the dawn. when the hunter-gatherer began to

his own food through agriculture and

VII.1. Post-Pleistocene Environment



At the height of the last ice age (or around Last Glacial Maximum, *ca.* 22,000 BC), the world presented a strange and largely

hostile appearance. Land temperatures had fallen from present-day norms by up to 20°C, tropical sea temperatures by perhaps 2° to 5° C, and northern Europe and North America were blanketed by ice sheets over 4 km thick. Pakistan, and, for that matter, much of the Indian subcontinent, was not frozen but its northern parts, down to Pothwar and the Salt Range, were surely glaciated. With so much water locked up in the ice sheets, world climate was marked by aridity. Major deserts expanded far beyond their present limits, and sea levels fell to 100 m below their present height, turning vast areas of what is now sea bed into dry land.

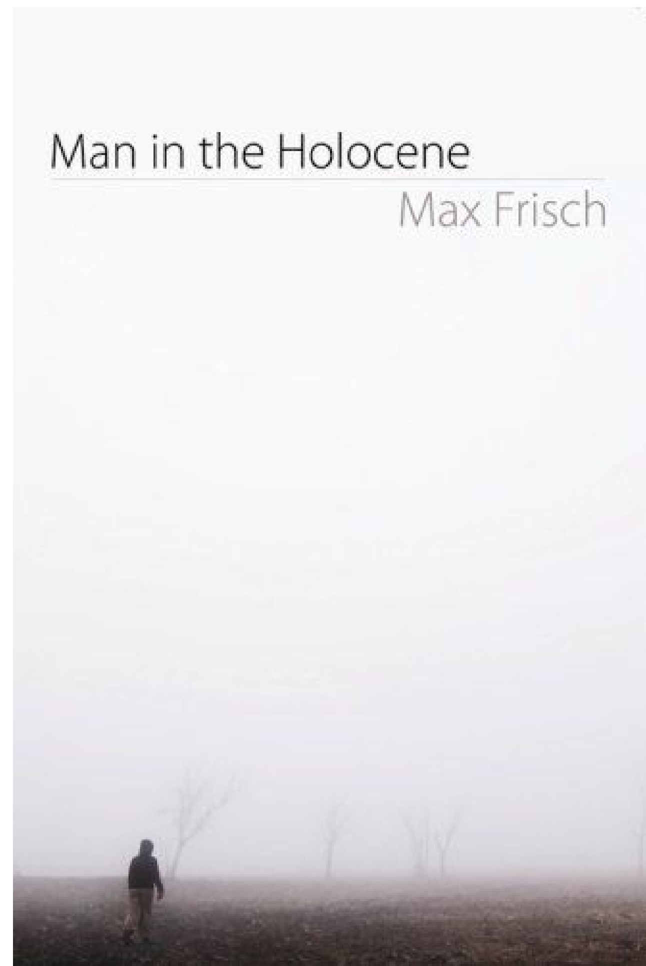
Around 18,000 BC the world began to warm up again, and the grip of the last ice age began steadily to weaken. The process was slow and irregular, marked by both chronological and geographical disconformities. The Pleistocene finally drew to a close as the glaciers retreated in regions where their traces are still found today. The climatic conditions more or less similar to those of today were established throughout the world, including Pakistan. This was the beginning of the Holocene epoch, through which we are presently passing.This provided the setting for man to make a number of important advances in his control of environment and set in motion a series of events that ultimately led to the appearance of the first urban societies, one on the western end of the Iranian Plateau, that is Mesopotamia, and one on the eastern edge, that is, the greater Indus Valley.

Aside from a rise in atmospheric temperature, there were some other climatic changes. For example, the winds which carry rains through tropical Africa and across the Indian Ocean moved north to pass over the Sahara and a large part of South Asia. These regions, which were previously dry lands, now became areas of lakes within an extensive savanna grassland. By the 8th millennium BC, pottery-using hunter-gatherers had settled several pockets of this vast region that included Baluchistan in Pakistan and the geographical area around the Euphrates River in the Middle East. Only during the 5th

millennium BC did climate patterns started to change again and these areas began to take on the desert-like character of today (24).

The changes in the environment that took place at the end of the Pleistocene undoubtedly stimulated more resourceful human groups to advance and diversify their methods of winning a livelihood from their surroundings. By 10,000 B.C., a millennium or two earlier or a millennium or two later, man was experimenting with domestication of animals and plants. Concurrently, some population groups began to settle at fixed locations that subsequently gave rise to early farming villages. Qualitatively, this was a tremendously important and highly significant turn in the cultural history of man: it put him on the path of civilization.

The interaction of climatic changes are complex. For example, a slight increase in average rainfall, or in its distribution throughout the year, or a drop in average temperature which reduces the



A photographic impression of Man in the later Pleistocene

amount of evaporation, may cause the margins of the desert to have a little more vegetation and support more grazing animals, and larger trees may extend into areas of grassland and thorn forest beyond their former limits. If the crucial factors are reversed their effects will be reversed also. Such changes can be crucial to the survival of a community, and they may necessitate a change in ways of life which will be registered in the archaeological record in a variety of ways, such as changes in the tools used or in the nature and distribution of living sites. In general, minor climatic changes of this kind have more effect in a marginal zone of low rainfall, for example, than in an area of high rainfall where a few inches more or less will not make much difference. In dry regions over-exploitation of the environment can have a similar effect to that of natural decrease in rainfall or humidity.

We shall not go any further into general discussion of climatic and environmental change on a global scale. Our main concern is here the long term climatic conditions in South Asia in general and Pakistan in particular during the temporal interlude that connects the Upper Paleolithic to the Neolithic, that is, in the loosely defined Mesolithic interlude. It would be instructive also to examine the various regions of Pakistan and assess the widely differing environments that its structure and climate



Shortage of water characterized the landscape of South Asia in the later parts of Pleistocene.

have provided for human communities.

Climatic Changes in South Asia: Though our knowledge on paleoclimatic variation in Pakistan and the borderlands is still limited, the study of pollens and sediments in Rajasthan, the analysis of fossil dunes in Cholistan, and the ocean cores from the Indus Delta indicate that there was a marked increase in rainfall in South Asia at the beginning of the Holocene epoch. The change in climate naturally affected both flora and fauna. Large animals gradually vanished and these were replaced with swifter and smaller animals such as various species of deer, cattle, sheep, goat, etc. The fish also became more abundant. Major ecological shifts occurred with the recessions of mountain glaciers, and climatic changes increased habitability of regions formerly too harsh or inaccessible for human settlement. The new environment thus created conditions for the availability of new resources, and in order to exploit them more effectively, it became essential for the Mesolithic man to make necessary modifications in his tool-types. His toolkit now consisted of the microliths and composite tools, which could be employed more profitably for hunting and scavenging as well as for collecting vegetal food.

The last glaciers in the north of the subcontinent probably receded 12,000 to 15,000 years ago and a more temperate climate started to prevail. This is the beginning of the Holocene epoch, which we are presently passing through. It is in this period that the level of man’s technology started to improve at an accelerated pace, his social structures started to form, and soon he began to produce his food instead of acquiring it by hunting and gathering in the wild. This chapter deals with the environmental conditions under which these changes were taking place. Particularly, it describes the environment of early parts of the Holocene epoch in South Asia and points to the cultural adaptation of human inhabitants to this realm.

As the ice sheet started melting and the glaciers began receding, the land masses gained elevation as a result of being freed from the weight of the ice. Swelled with increased water from the melted glaciers, ocean and sea levels rose, submerging coastal and low-lying areas and reducing the land available for human and animal occupation. For instance, what is now the Persian Gulf was above sea

level before the glaciers melted and would have been a favored environment for humans, animals, plants, and riverine life.



In the early Holocene, starting ca. 12,000 years ago, rainfall increased in South Asia and atmosphere became somewhat moister. The drylands generally became grasslands and the deserts became somewhat

more hospitable. The grain-bearing grasses played a crucial role in the diet of humans prior to the development of agriculture

The ice began to melt around 18,000 years ago and the sea level rose rapidly but the atmospheric conditions did not get much warmer for some time, because the temperature of the sea remained cold due to melting ice. This was a time of maximum aridity in tropical and semitropical regions, including Pakistan, when many lakes and rivers dried up. By about 12,000 years ago, however, the rate of sea-level rise began to slow down, the sea became warmer and rainfall and humidity increased. Forests and grasslands spread into previously arid regions, deserts contracted, and rivers flowed more regularly, carrying silt in suspension rather than carrying coarse material when in spate. Inundations were frequent and severe, which made the human settlement on the banks of large rivers impossible.Humans and the animal herds, therefore congregated around lakes, small rivers, and water springs.


A view from Cholistan Desert

As these climatic and vegetative changes occurred, large herds of mammals were replaced by more solitary animals, such as red deer and wild goat. In Europe and northern Asia, the cold-adapted animals, such as the reindeer, elk, and bison, retreated to further north, while others, such as the mammoth, giant deer, and woolly rhinoceros, went extinct. And, as plant and animal species adapted to newly established environmental settings, so did the post-Pleistocene hunting-foraging human communities seize opportunities to pioneer a broader range of habitats. By 8,000-10,000 years ago the climate stabilized to more or less what we experience today, of course with some minor periodic variations. This was an important landmark in human development all over the Old World. The improvement and diversity of the environment provided humans the opportunity for cultural and technological experimentation.

During the latter part of the Pleistocene and the early part of the Holocene the pattern of climatic change in South Asia was on a scale and of a nature as to leave a consistent, recognizable pattern upon the landscape throughout extensive regions of the subcontinent. Dead drainage systems have been recorded throughout much of the Thar desert between the Indus and the Aravalli hills, indicating a widespread increase in humidity. Fossil dunes can be seen along the eastern margins of the desert from the Arabian Sea almost to Delhi - a distance of approximately a thousand miles. The pattern of rivers building up plains and filling valleys, and subsequently incising their channels into these deposits is evident over a large area. These changes can be associated with comparable phenomena in other arid regions of the northern and southern hemispheres. They can therefore be attributed primarily to world-wide causes, modified by tectonic events, also part of a world pattern, but of a particular continental character in their effects.

The archaeological history is often interpreted in light of environmental constraints. Unfortunately, the focus of these interpretations in South Asia has been on the catastrophic events, with little appreciation of the Late Pleistocene and Early Holocene geomorphologic evolution. Whereas some archaeologists have been accused of viewing the landscape as static, the interpretations of others are an interesting combination of an effectively static landscape only intermittently impacted by largemagnitude catastrophic events, such as Toba eruption in Indonesia or the frequent tectonic upheavals in the Northern regions of Pakistan and Baluchistan generally. Thus, almost all environmental change has been attributed to either earthquakes or prolonged droughts, with little appreciation of the landscape response to climate change, sea level rise, sediment transport, and severe flooding.


An oasis in the midst of the dryland in southern Baluchistan

The reason is obvious: we do not have much of environmental data and practically non-existent environmental history of the region that can provide a setting for painting a gradualistic perspective of the post-Pleistocene environmental and its impact on cultural evolution of the region while still recognizing the importance of the short period events. Rather than painting an environmentally determined picture of cultural evolution in this region, archaeologists and anthropologists who have worked here attempt to paint a picture of major cultural changes whereby external factors (such as migrations from the west) provide the canvas on which archaeological history is painted rather than concentrating on the effects of environmental constraints.

Dryland and Deserts: Another aspect which is equally important in the study of Late- and post-Pleistocene environment is to take into account the process of desertification of the dry area which is virtually the whole of the Indus Valley and Baluchistan. The greater part of Pakistan with the exception of a broad belt along the Himalayan foothills and the plains of the northern Punjab, virtually forms an extension of the western Asiatic and Iranian desert lying to the west and north-west, from which it is divided by the rich but narrow belt inundated by the river Indus and its tributaries. In terms of human environments this presents a pattern of regions of arid conditions, not unlike those of Western Asia.

Notwithstanding the presence of some pockets of early populations around permanent water sources, the lower Indus Valley as a whole is characterized by extreme environmental juxtapositions: a hyperarid desert with annual rainfall of 5 mm/yr or less, dotted with lush riparian oases that parallel the rivers draining the eastern face of the Iranian Plateau and adjacent to one of the world's most fertile marine ecosystemems fed by strong coastal upwelling in Makran coastal belt. For a moment, we shall concentrate on this region of hyperaridity, the dry zone of Baluchistan, and the coastal areas of Makran and the sandy deserts of Sindh. This area combines a rich and reasonably well-known archaeological history with sufficient Quaternary geology to allow us a correlative analysis. The pockets of human populations where agriculture and sedentary living was first detected, should be of our special attention.

A number of schemes subdivide the prehistory of this region, and the interpretation of that prehistory colors the various schemes. Put simply, the story is of quasi empty quarters that were very sparsely populated by hunter-gathers during the Late Pleistocene, followed by the development of sedentism

uniquely founded on the hunting of wild goats, deer, and other animals, and foraging on wild barley and other seed-bearing grasses. Marine resources played only a minimal role. An expansion of these communities along the various tributaries of the Indus eventually led to agriculture and animal husbandary. With the development of agriculture, and a slowly, perhaps hesitantly, societal complexity increased and regional states came into being. In this story, as it is developing in more recent time environment is playing a dominant role while that of external migration from the west seems to be relegated to the category of old fashioned Eurocentric dogma.
The presence of hunter-gatherers in the Middle Pleistocene is confirmed in most of the areas of this region. The microlith producing people abound in southern Sindh, southern Baluchistan, and most likely in the coastal areas but little is known of human occupation in much of Baluchistan and the upper Indus Valley prior to about 10,000 years ago. In the coastal strip and the lower Indus Valley generally, there is clear evidence for a hunter-gatherers population during the Mesolithic transition, i.e. by 15,000 years ago. This population appears to have been migratory, living along the river banks, around freshwater lakes, in the river-fans of Kirthar range and Las Bela plains, and by the occasional water springs. The primary record of this occupation is lithic scatters, largely microliths but also other types. In much of Baluchistan, which suddenly came into prominence at the advent of agriculture, we do not have any Paleolithic or Mesolithic sites, not even an occasional micriolith find. The Murri-Bugti country, however, seems to be an exception; there an assortment of micrioliths, bladelets, and scrapers have been reported, although not confirmed.

Around 10,000 years ago the transition to a more sedentary lifestyle was in full swing in Baluchistan. This is confirmed at Mehrgarh in the Kachi plain, on the border between Sindh and Baluchistan, as well as at the site of Kili Gul Muhammad in the Quetta Valley. The most common archaeological remains of this time are bones of wild goats, sheep, cattle, and deer. There is some evidence of domestication also. Along with the bones, charred seeds of wild barley have been found. Apparently, the process of domestication and sedentary living had already started. The transformation is, however, not uniform. It appears that the populations in costal area and the Indus plains still remained foragers, as the shell middens in the coastal area indicate.

The deserts of Sindh and Cholistan have been adequately researched; some of the results are reviewed in the next two chapters. The region is crisscrossed by ancient lakes, dried-up water streams, oxbows, and extensive fields of dunes. The evidence for prehistoric occupation in the desert is not rare. The paleolithic sites on the banks of the Indus, around Hyderabad and Rohri Hills, go back to the early Paleolithic times. Biagi has uncovered dozens of Mesolithic sites spread over the whole area of Sindh and Las Bela. As detailed in the following pages, there is hardly any major area of Sindh where microliths are not found. The artifacts in coastal area around Karachi have been particularly abundant.

The dryland of Baluchistan, on the other hand, has scarcely been touched. It is a stark landscape of exposed bedrock and alluvial fans. With rare exceptions, life in this desert is restricted to narrow valley oases. In most instances, the boundary between the vegetated and barren land surface lies precisely at the edge of the outermost source of underground water or the outer bank of the seasonal water stream. It is in these valleys where agriculture first began and it is these pockets where the hunter-gatherers of the Upper Paleolithic most likely congregated.

Recent research in the Thar Desert and its borderlands indicates that Baluchistan and Sindh experienced rainfall well above present norms, 6,000 to 4,500 years ago, as attested by gabarbands

(stone-built dams and terraces) that were first identified by Aurel Stein in southern Baluchistan. This wet phase probably extended back to ca. 9,000 years ago. Cholistan was drier during the last glaciation, but it, too, had a humid phase, as shown by extinct channels of the Ghaggar plain and Luni basin that were cut by 7000 B.C.

The end of the arid phase in the Thar, and the dry zone around it, is marked by the sudden appearance of microliths. In the present arid zone extending from Las Bela in Pakistan and across Rajasthan and Gujarat to eastern Punjab these small stone tools cover sand hills of considerable antiquity. These fossil dunes exhibit signs of severe denudation, water having cut deep channels, and calcification has developed. The presence of microliths on dune surfaces indicates minimal sand movement over the past 10,000 years. This situation coincides with the period of time when dune movement came to an end. Parabolic, transverse, and longitudinal type sand hills have been preserved since the end of the Pleistocene.

It is interesting to note that during this wet period, little evidence is at hand for human settlement along the large rivers, such the Indus. Probably the inundations were so severe and so frequent that humans could not congregate along these water bodies for any length of time. It was only after an eventual decrease in the monsoon activities occurred in the north that the Himalayan rivers lost their strength and the severity of their annual inundations substantially decreased. Human settlement in the plains was now possible along the river banks and a number of settlements in western Sindh emerged in the fourth millennium BC (24).

There is evidence of fairly widespread climatic fluctuations of a minor kind during the late Pleistocene and early Holocene from many parts of the world, and there can be little doubt that, like the more marked variations of the Pleistocene, some of these were part of world-wide patterns. In some cases, regional factors have proved stronger and dominated the world-wide pattern, at any rate in terms of the surviving evidence. In others there is evidence of quite marked regional or local change apparently unrelated to wider patterns. Regional and local fluctuations of climate and some of a more widespread nature, have taken place during historical and recent times in many parts of the world, including South Asia, for instance the drought in the Sahel region of West Africa, and the succession of drought years during the 1970s in Western India. In marginal regions such as the Thar, where rainfall is very uncertain and variable in the best of times, there have also been droughts of a more localized kind. In all these cases the causes are complex, and human activities have been suggested to be taken into account as contributory factors.

Human-induced Changes in the PostPleistocene Environment: It is possible that by the end of the Pleistocene human groups were bringing about changes in their environment, consciously or unconsciously, by such means as burning off forest and grassland by accident or design; reducing certain species by excessive hunting or overkill, and thus altering the natural balance of wild life and the environment in general; and protecting and increasing the number or range, or both, of other species. But it is probable that at this stage the effect of man upon his environment was marginal, only effective in particularly sensitive areas, In general man was still largely at the mercy of his environment. The changes in the environment that took place at the end of the Pleistocene undoubtedly stimulated more resourceful human groups to advance and diversify their methods of winning a livelihood from the resources of different environments.

During the Mesolithic the principal means of subsistence were hunting, fishing and gathering. These

activities had a supposedly small and local impact on the vegetation, with little effect upon vegetation composition and pollen deposition and thus easily overlooked in pollen diagrams. To assess the effect of human activity on the environment, high-resolution studies are needed for smallscale changes in vegetation or occupation phases to be detectable. Such studies, of course, ere not available from any part of Baluchistan and the Indus Valley. The pollen studies that have been conducted in India on the Pakistan-India borders within the Thar Desert are contradictory and do not shed any light on the human impact on environment.

VII.2. Transition to Settled Life - A Mesolithic Interlude



By 30,000 years ago, with the Neanderthals ousted from Europe and Homo *erectus* confined to a relict population in the forests of Flores, modern humans had replaced or absorbed the archaic people who had occupied the world outside Africa for more than a million years. But in a sense, nothing had changed. The modern humans, like the archaics, were foragers who lived off nature's bounty. They built nothing and left almost nothing behind, save for their stone tools.The newer humans crafted tools of far greater sophistication, including many of bone, and made works of art such as ivory figurines and the decorated caves of France and probably many other spots. But they were still nomads, barred by their mobile way of life from all the material and intellectual possibilities of settled life.

These hunter-gatherers had one more great transition to make before entering the history of civilization. They had first to abandon their nomadic way of life and settle down in fixed communities. This transition occurred at the end of the last glaciation, the close of the Pleistocene epoch, or the beginning of the Holocene, some 15,000 years ago. The last ice age drew to a close as the glaciers retreated in regions where their traces are still found today. The climatic conditions more or less similar to those of today were established throughout Asia, including Pakistan and its borderlands. This provided the setting for man to make a number of important advances in his control of environment, and set in train a series of events which led ultimately to the appearance of the first urban societies, one on the western end of the Iranian Plateau, that is, Mesopotamia, and one on the eastern edge, that is, the Greater Indus Valley.

In the time period between 15,000 and 8000 B.C. we notice all over Western Asia, up to the Indus Valley, a wide variety of cultural adaptations by human race. The Upper Paleolithic, just preceding this time, had experienced a climax of cultural achievement of sort and *Homo sapiens* were starting to engage themselves in diverse technological innovations. The evidence suggests that man was evolving from the simple band level of social organization to one of more complexity. This probably was motivated in part by the need for collective efforts of large scale not only in the economic pursuits of hunting and gathering but in ceremonial activity as well, the latter permitting a more

formal interaction with the animistic qualities of nature than ever before. Totemism and sympathetic magic, belief in an afterlife, and shamanism, are suggested by the evidence available at various locations in the Old World. These traits were apparently acquired during the Upper Paleolithic and it intensified during man's transition to agriculture and sedentary living which was to come.

During the same time, at least in Southwest Asia, man was experimenting with domestication of animals and plants which eventually led to agriculture and animal herding. These developments in subsistence regime necessitated the establishment of fixed settlements and gave rise to early farming villages. Or, was it the other way round? Indication from the Near East, where most of the research work has been done, is that sedentary living came before agriculture and pastoralism. Indications from parts of Pakistan and the adjoining areas of India are also in the same direction. Whatever may be the case, qualitatively it was a tremendously important and highly significant turn in the economic and cultural history of man: it put him on the path of civilization. These profound and rather fundamental changes in human culture did not appear suddenly from the blue; they were the result of technological knowledge that man had accumulated over the millennia past. A rapidly changing climate probably also gave him a needed incentive to innovate and too severe for their flanks to be occupied. As the monsoon rains subsided from the 4th millennium BC onward, the inundations started to be less frequent and less severe. The river flanks became habitable and a large number of agricultural villages started to emerge in western Sindh.

Mesolithic, Epi-Paleolithic, or Neither: By the end of the Pleistocene epoch man was making sophisticated small tools (the *microlith*), which he sometimes combined with other implements to fashion *composite* tools, such as a sickle, saw, and a tipped arrow. His toolkit was now large and included scrapers, burins, drills, grinders, polished handaxes, along with earlier tools such as choppers. This inventory of varied and specific tools gave him a high degree of technological flexibility and made him much more efficient in hunting and gathering than what he had so far been. At the same time, his emerging skills in taming and breeding of wild animals and his dexterity in harvesting of grain-bearing plants must have given him a reason to settle down in fixed villages and, as a result, one must have seen a lesser mobility of people and their increasing concentration within a few favorable pockets in each geographical area. This transitional period between the life of hunter-gatherers of the Late Stone Age (the Upper Paleolithic) and the settled life of agriculture and pastoralism (the Neolithic) is generally known in archaeological circles, as the *Mesolithic*. Quite often *Mesolithic* is equated with *microlithic*. This may hold good for Europe and to some extent parts of East Africa but the two are not always synonymous. Microlithic is a technological term, while Mesolithic is a general cultural term describing a way of life.

Like so many other archaeological terms, Mesolithic is specific to Europe, although its use has also been applied to other regions in the past. In Southwest Asia, the final millennia of the Late Pleistocene are increasingly labeled as EpiPaleolithic (late Paleolithic). The term Mesolithic is also not used in North America, nor is the term employed in Australasia or most of Africa. In India and Pakistan the definition seems to be free-for-all. Some authors use the term Mesolithic in conformity with Europe but some prefer to call it the EpiPaleolithic. Some would even deny the existence of a discrete cultural period that can be named Mesolithic, Epi-Paleolithic or anything else. These scholars would rather view this transitional period as the terminal part of the Upper Paleolithic as a continuum. Robert Braidwood (1), the eminent archaeologists whose work and thought shaped a generation of research on the problem of plant and animal domestication in the Middle East, placed the most important locus of change not on the subsistence system *per se*, but on the evolution of what he called the "primary

village farming community". Allchin considers that "[the] Mesolithic is a more comprehensive cultural term, as it designates their position in the industries of hunting groups, or communities partly dependent upon hunting, in many cases overlapping in time with settled agricultural and urban communities" (2). Well, such statements do not tell us much; they muddy the water even more.

This confusion or a lack of terminological uniformity probably stems from the criteria of definition one uses. Some archaeologists have defined this period purely in terms of the stone industries, i.e. the *microliths*. Some others have tried to define the Mesolithic in general cultural terms of which the mode of subsistence plays a dominant role. This debate still goes on, sometimes passionately, even virulently. As a result, Possehl complains that "confusion over the definition of Mesolithic – settlement and subsistence versus typology – has muddied much writing on Indian sites with microlith technology" (3). Reviewing archaeological literature emanating from India and Pakistan, it appears that the confusion is not so much a matter of definition but rather of not adhering to a definition. For example, Misra, a prominent Indian archaeologist, suggests that "the Mesolithic represents a transition, lasting only a few thousand years, between the Paleolithic and the Neolithic period" (4) but then routinely calls any site that contains microliths a 'Mesolithic' site without any temporal context or evident cultural change.

The Western concept of a Mesolithic cultural tradition, forming a defined link within an assumed progression of cultural stages, has been largely accepted by interpreters of the South Asian archaeological data. Recent studies, however, demonstrate that the European definition of the Mesolithic through the typology of stone artifacts often fails to explain the transition from the Stone Age to settled life and from food gathering to food producing societies in South Asia. In this region, we do not see any discrete and well defined period which we can term the 'mesolithic' in line with the European definition for such a transitionary stage. At the same time, we also do not have a visible Epipaleolithic period of the Levant which clearly lead to plant and animal domestication and sedentary living. A cultural and technological change is no doubt in the air but it is more in context of a change in the Paleolithic rather than a harbinger of the Neolithic.

In a sense the debate on nomenclature is useless for South Asia generally. First, the research data is scanty. Second, this transitionary period has already been defined in term of the microliths rather than viewing it as a cultural stage. Third, there is no clearly defined chronological or cultural horizon; its time span may range from the Upper Paleolithic to the Iron Age and it may often cover the huntergathers bands of Gujarat on oner hand and settled semi-agricultural communities of South India on the other. In this situation, we do not have any choice but look at this transition rather loosely - a cultural time period that intervenes between the Paleolithic and the Neolithic. This obviously depends on region to region. In the interest of simplicity, however, we shall keep on calling it the Mesolithic Transition.

Microliths: A microlith is a small stone tool usually made of flint or chert and typically a centimeter or so in length and half a centimeter wide. It is produced from either a small blade (microblade) or a larger blade-like piece of flint by abrupt or truncated retouching, which leaves a very typical piece of waste, called a microburin.

Microliths were subsequently hafted onto bone or wooden handles to form *composite* tools. The advent of microliths, however, does not mean that the earlier types of tools became redundant; these tools, for example handaxes, choppers, cleavers, etc, were still fashioned and used, although the

microliths and composite tools carried the day.
Two families of microliths are usually defined: laminar and geometric. Laminar microliths are associated with the end of the Upper Paleolithic and the beginning of the Epipaleolithic period; geometric microliths are characteristic of the Mesolithic and the Neolithic. Geometric microliths may be triangular, trapezoid or lunate. Regardless of type, microliths were used to form the points of hunting weapons, such as spears and (in later periods) arrows, they are found throughout Africa, Asia and Europe.

A bow begins to be used in many parts of the world, so probably in some parts of Pakistan. Fishing hooks have been found made of bone. These are thin and rather delicate. Many archaeologists believe the Mesolithic people used nets for fishing; however, nets are not preserved in the archaeological record. For larger sized fish, harpoons came in used and there is some evidence for their use in preceramic Mehrgarh in Baluchistan.

Since our evidence for this period of human history comes largely from archaeological sources and since these sources mainly constitute the stone artifacts, it has been a general tendency on the part of archaeologists and prehistorians alike to define this period in terms of the typology of stone tools and their manufacturing technologies. The *Mesolithic*, therefore, has became synonymous with the *microlith*.

A note of caution must be struck here. The beginning of agriculture and animal domestication is considered the terminus of the Mesolithic or EpiPaleolithic transition. At the same time, the use of microliths is also recognized as the hallmark of this period. These two criteria, however, do not always coincide and attempts to define the Mesolithic on the basis of the microliths alone are unlikely to be helpful and may readily be misleading. Microliths occur in abundance in Pakistan as well as in India and Afghanistan but their context is often undetermined and some are quite late.

For example, throughout the Indus system most of the microlithic industries so far recorded are

Confusion over the definition of Mesolithic – settlement and subsistence versus typology – has muddied much writing on Indian sites with microlith technology.

(*G. L. Posseh, The Chronology of Prehistoric India from Earliest Times to the Iron Age.*)

associated with what appear to be permanent settlements. These include agricultural settlements of the Early Indus period as well as those of earlier periods with a less developed sedentary character. There are a number of diminutive industries in Sindh which are in no way pre-agriculture or preHolocene. A good example of this is the Bronze Age diminutive stone tools associated with Harappan sites, such as Allahdino near Karachi. Similarly, it is common-place in South Asian archaeology to find sites where microlithic tools are associated with copper artifacts and ceramics, such as the postHarappan sites in Gujarat. There have been two reports from India of “microliths” made from bottle glass, which would imply that they were made after the seventeenth century A.D.

Although microliths were used by many hunter-gatherers groups, evidence shows that they are neither unambiguous indicators of a hunting and gathering culture nor are they chronologically restricted to a specific period in human history. In view of this situation and given the unresolved confusion in terminology, we are better off using Microliths for a change of style in stone tool tradition, much like

the changes in pottery and other artifacts that h a v e b e e n u s e d a s markers in later prehistory, while employing the term Mesolithic to represent a cultural period that is transitional to the Neolithic at the terminal stage of the Stone Age. Microlith must not be allowed to become confused with the complex evidence of more profound cultural change, that is, the Mesolithic. It is in this sense that we need to approach the Mesolithic as a cultural stage or a period of cultural transition from the Upper Paleolithic to the Neolithic. It would be even advisable to call this cultural stage, transitional or not, the Epi-Paleolithic, reserving the term Mesolithic as a technical term specifically applicable to Europe. We should also wean ourselves from the habit of using the term "microlith" for every stone tool that is ‘small’. If we cannot comply with the meaning of microlith, as used in the archaeology of Europe, we better not use it at all.

Intensive Foraging, Decreased Mobility, and Human Societies of Increased Population Density: Throughout the Paleolithic times, man moved with his chosen game and followed his vegetational resources of food on seasonal basis. As the animals migrated, so did man. Similarly, as particular plants on which he depended for his living diminished in one area, man moved to another whose climatic conditions were still conducive to the growth of these plants. During the Mesolithic all this seems to be rapidly changing. Instead of hunting only a few types of animals and seasonally migrating with the game, man broadened the choice of animals that he could hunt and consume. Similarly, instead of relying on only a few plants or their fruit and seed for his survival, he widened his choice of plants that grew in the area of his residence under changing climatic conditions. Thus, he could remain within a confined area throughout the year and still had plenty of food at his disposal. The essence of hunting and gathering economies of this period, as opposed to the Paleolithic before it, was to exploit many resources lightly rather than to depend heavily on only a few. At the same time, man’s emerging skill in taming and breeding of wild animals and his dexterity in harvesting of grain-bearing plants must have given him a reason to settle down at fixed locations and, as a result, one must have seen a lesser mobility of people and their increasing concentration within a few favorable pockets in each geographical region. Several small but concentrated human populations thus subsisted on whatever resources were available within their territory and they adapted to conditions as they found them.



Microliths are the technological hallmark of the Mesolithic Transition

All of this obviously fostered the development of regional cultures. For instance, in the northern temperate zone of Europe we have shellfish gatherers, stag hunters, reindeer hunters, and fishermen,

while archaeologists found that people living at Belt Cave near the Caspian

shore of northern Iran were largely seal hunters. The result of this decreasing mobility, increasing population density, and resource diversity was dramatic and after 10,000 B.C. We are bewildered by the archaeologist's use of a great number of names all designating particular cultural forms or situations but each an entity of itself. Hamburgian, Natufian, Zarzian, Sebilian, Magosian, Azilian, Tardenoisian, Maglemosian, Capsian, etc., are all designations of food-gathering and collecting cultures operating within reasonably restricted areas. This is in contrast to the earlier Stone Age terms such as Abbevillian, Acheulian, Mousterian, Gravettian, etc., which have a far broader and less regional meaning

Coming to the Greater Indus Valley, the warming temperatures throughout west and south Asia brought significant environmental and vegetational changes. As early Holocene temperatures rose, plants like wild emmer wheat and barley and fruit trees like almond, pistachio colonized more fertile, higher country on the slopes of the Iranian Plateau. These abundant cereal and nut resources within the Near Eastern and Baluchi hill zones stimulated the development of more *intensive* foraging strategies and these, in turn, made sedentary settlements feasible at certain areas of West and South Asia. This is reflected in the emergence of agriculture and animal herding within the same areas somewhat later.

The known sites of these characteristics lie in the hill zones of the Near East, where cereal grass stands and fruit-bearing trees were most abundant. They lie close to boundaries between the grassland valleys and the hilly zone. It is believed that a similar situation must have prevailed on the hilly flanks of the Baluchi hills where some locations allowed the Indus people to enjoy many months of plentiful food by exploiting first spring cereals and then fall nut harvests as they ripened at progressively higher elevations. Gazelle and wild goat hunting assumed great importance at certain seasons of the year, with neighboring communities cooperating in game drives, ambushes, and other mass hunting enterprises. The implication is that wherever cultures of the period were situated, they were exploiting that particular environment to the utmost of their technological abilities. This is in an apparent contrast with the previous situation where huntergatherers were extremely mobile and their food was not of much broader spectrum. It is believed that this concentration of resources and the resulting flocking of people around them year round paved the way for humans to engage in activities that were the harbinger of plant ad animal domestication. The Natufians of the Levant was one such group for which we have sufficient archaeological evidence as to construct their lifeways in some details. Some of these details could be of universal application.

On the Mechanism of Transition: The Mesolithic cultures wide variety of hunting, fishing, and food gathering techniques. This variety may be the result of adaptation to changed ecological conditions associated with the retreat of glaciers, the disappearance of large game of the Ice Age, or, alternatively, a result of the advances in technology. There is strong evidence that food *gathering* started to be augmented by food *collecting,* that is, hunting and gathering of food continued to be the main supply of food but the humans began to *store* food for later consumption. Taming or even domestication of some animals is the main development of this period. Microliths (small tools), the

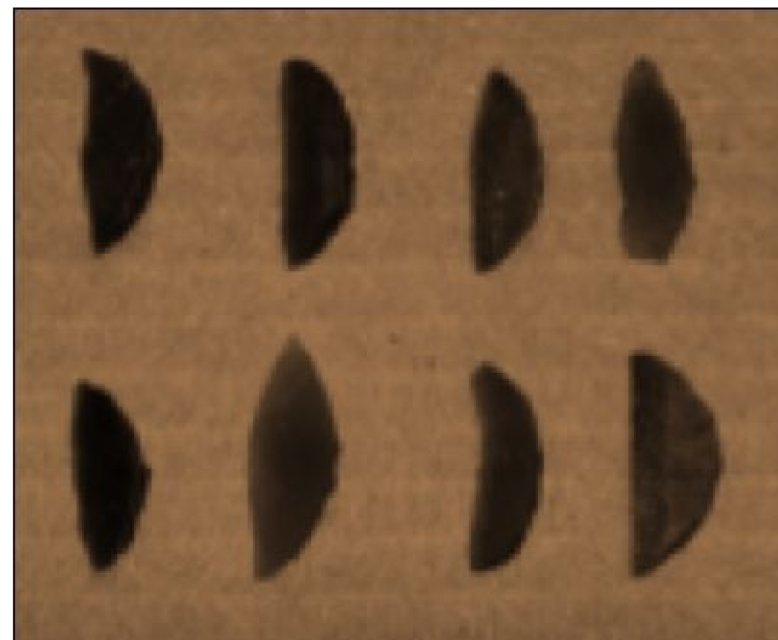
typical stone implements of the Mesolithic period, started to prevail and some composite tools started to be made and used. Polished tools also started to appear in several parts of the Old World but their frequency in Pakistan and India is very low at this stage of the game.

In reviewing the archaeological evidence for the period, it becomes clear that man, wherever he is found, was in control of his subsistence resources in the sense that he was thoroughly aware of seasonal changes and animal habits and was a master of the techniques by which to obtain the maximum results within the capabilities both of his empirical knowledge and his evolved technology. Some have

Mesolithicrepresent a


Microliths are found in diverse shapes and forms, most frequent are scrapres, geometric bladelets, and lunates


Examples of a type of geometric microliths from upper Sindh


The so-called 'lunate' microliths from lower Sindh

called this control-awareness an intensification of hunting and gathering and speak of it as a kind of reaction to the challenges of the post-Pleistocene landscape. Within Pakistan, such intensification of hunting-gathering efforts must have occurred with special vigor around fresh water lakes in the Lower Indus Valley where isolated watering holes must have provided suitable vegetational cover equally for men and beasts. In some of these early camps and settlements the resources were optimum and the hunting gathering bands continued their way of life for several thousand years.

In other valleys, such as those in Iranian Plateau, the available natural resources for adequate hunting-gathering may not have been sufficient: these people turned to adapting to the changing environmental conditions by experimenting with domestication of plants and animals in order to augment their food supply from their regular hunting gathering activities. There is evidence from the areas to the west of the Indus and northwestern borderlands that some isolated communities of hunters-gatherers took up with storing of their surplus food. Thus, the supply of food became somewhat more secure. It also necessitated the establishment of some permanent or semi-permanent camps where they could return much more frequently than before.

Another scenario stipulates that by the end of the Pleistocene the big game started to vanish for lack of abundant foraging that was available to them in colder climate. The remaining game started to concentrate in smaller and smaller areas that provided sufficient grazing and water. The huntersgatherers, who till then were diverse bands of 10 to 100 men, women and children, and wandered long distances for the available game, now started to concentrate into larger groups around the newly created concentrated pockets of game on the slopes of the hills and in the plains of the valleys. This factor intensified the exchange of ideas and develop some mutual arrangements between diverse hunting-gathering bands to share the available resources without any violent conflicts. A social base of a semi-settled life was thus formed which helped them to evolve into true agricultural villages at a later stage. This theory, thus, puts the evolution of social culture before the evolution of agricultural technology and empowers man to consciously control or even change his environment.

Some researchers have argued that domestication took place because the population pressure moved hunting-gathering groups out of the optimum hunting-gathering areas into marginal zones where, in order to survive, man had to exploit the indigenous plants and animals intensively, the domestication being a part of this effort. Where the scarcity did not prevail, the hunters-gatherers continued their traditionnal way of living although at somewhat more efficient level. This is similar to Toynbee's challenge-and-response hypothesis. Provocative as this idea is, it seems to assume that optimum conditions are necessarily inimical to innovation. In other words, necessity is the mother of invention.

The development of incipient agriculture and animal domestication requires man and the potential domesticates to be in proximity as a first premise. Second premise is that domestication must precipitate out of the first. There is evidence that as early as 25,000 years ago men were selecting out certain animals and plants as the basis of their subsistence. The whole Upper Paleolithic of the Near East is generally demonstrative of this trend, and the Mesolithic or terminal food-gathering era, which follows, is equally demonstrative of it. The peoples living in ancient Pakistan must be acting the same way although no research is available in this area so far.

The fashion of selecting out a given plant or animals as a staple of the diet is probably due to the ability of man to obtain that form for food and pro


Reconstructed examples of composite tools

longed its uses through storage. This ability improved with the technological developments, such as sickles, grinding stones, fire, and very probably wooden vessels or underground storage pits. It is, therefore, not far-fetched to think that during the transition the ancient man not only could reap wild cereal plants in a short intensive period of the year but was also able to store the abundance obtained.

Selection does not mean narrowing down to the extent that other forms of subsistence were ignored. It does mean, however, that men tried to remain in proximity to their subsistence ideal – that is, to whatever was the main staple of their diet. There are numerous sites in the stratigraphy of the Upper Paleolithic and Epi-Paleolithic in the Near East that demonstrates this fact: men did not move away from their natural habitat but made every effort apparently to replace staples with others if the former was in short supply. True, seasonal migratory routes changed and territories shifted as the game and the supply of vegetational staple food waxed and waned. A consequence of this condition was that man had to widen his choice of food and had to do with what was available. This subsistence phenomenon has receive quite a bit attention in recent years and is generally called ‘broad spectrum foraging’.

Since it is a *transition* period, by its very nature it must consist of mixed economies, varied types of lifestyles, and a whole range of social structures. It must represent a continuum between the nomadic hunters-gatherers on one extreme and settled villages or simple camps on the other. Furthermore, this period must represent a rapidly changing society that supported not only the Paleolithic hunters-gatherers but also the incipient agriculturists and pastoralists. It is presumed, and there is strong evidence for it, that all those modes of subsistence coexisted with each other. It is also logical to presume that the composition of this continuum differed from region to region. The Mesolithic transition, therefore, must be viewed a continuum of the developmental processes of the Paleolithic in its later stages.

The Natufian culture in the Near East, where most of research work has been conducted, is a known primary example of transition from the Paleolithic to the Neolithic. Termed *complex foragers*, the Natufians are known from many Levantine sites, such as Shubakh Cave, El-Wad Cave, and ElWad Terrace. Natufian culture emerged around 15,000 BC and constitutes a major turning point in human prehistory because it provides the earliest signs of food production and decreased mobility. Natufian sites range in size from small base camps to villages. The villages contain dwelling structures, stone tool industries including new tool types of picks and sickles, animal bone tools, and stone grinding tools. Graves are found in all the larger settlements. They often contain more than one individual and thus provide the first evidence of cemeteries. Several burials with the skull removed have been found, and many skeletons are decorated with shells, bones, and animal tooth pendants. This evidence indicates a social pattern of treatment of the dead, perhaps involving beliefs about an afterlife or supernatural realm. The animal bones and stone tools found at various sites in eastern Baluchistan

form the chief evidence of the subsistence pattern of the early settlers of Pakistan but so far no campsite from the pre-settlements times has been uncovered.

The seasons would have been marked by alternating dry and wet or cold and hot periods, inflicting considerable stress on humans and putting their subsistence in jeopardy. One way of dealing with such environmental stress, besides the adoption of semi-permanent residence in one place, was the deliberate management of plant and animal. Microscopic studies of the edges of Natufian sickles show that they were used to harvest wild cereals. The use of a sickle increases the yield of seeds from grain plants. Natufian people used large stone mortars to grind wild grains - the first evidence of cereal processing. In the Zagros mountains, in the northern Levant region, Mesolithic people began to manage animal populations through selective hunting practices. Selective killing of adult male gazelles indicates that people were deliberately removing non-reproductive members of the herd to ensure that herd size and survival would not be jeopardized.

The area of the Fertile Crescent in the Near east has been subjected to extensive research with regard to the origins of sedentary living and development fog agriculture. The knowledge gained in this region could possibly be applied to other areas, such as Pakistan, where research activities have not been as robust. The environments on the eastern slopes of Baluchistan hills are quite similar to the western slopes of the Zogros and the plains of the Tigris and Euphrates mimic the plains of the



During the Mesolithic Transition most people in Pakistan lived in man-made shelters rather than in caves, as they did in several regions

Indus. Thus, any findings made in these areas could be useful in speculating on the Mesolithic transition from hunter-foragers to early farmers in Baluchistan and western Sindh. It is in this context that we chose to look into the life of the Natufians at such a critical and transitionary juncture.

The Emergence of Social Organization: Serious problems prevent an understanding of foraging lifeways in the Early Holocene as most microlithic sites are not dated and there have been very few studies which aim to retrieve archaeobotanical and faunal remains. As a result, interpretations about the activity and adaptations of these hunting and gathering societies are severely hampered. Further complicating the situation, it is clear that agriculturalists use microlithic technology and trade with foragers, thus making it difficult to clearly differentiate and discern foraging patterns from the task-oriented activities of farmers and pastoralists. All what we know is through comparative studies of

some living societies of hunters and gatherers or semi-agriculturists and pastoralists in some parts of India, Australia, and Africa, the reference to which will be made in subsequent pages.

Archaeological evidence points to one significant social factor that decidedly helped to promote a sedentary lifestyle: man's presumed capability to store food in the time of plenty to consume when there was shortage. Storage rooms have been found in settled communities of Mehrgarh and other places in Baluchistan, going as far back as 7th millennium BC. It is presumed that the practice of grain storage originated *before* the beginning of agriculture, that is during the transition from the Upper Paleolithic to the Neolithic agricultural revolution.

Where and When? While the definition of the Mesolithic as a culturally transitional phase between the Paleolithic and the Neolithic is gradually falling in place, its chronology is still up in the air. It must, as stated earlier, differ from region to region but the problem is that we do not know about this phase even at any one specific place. In context of Pakistan as a whole, we talk about a time period between 12,000 B.C. to 7,000 B.C. in the South and between 4,000 to 3,000 B.C. in the North. Nominally, some would like to bracket it between 9,000 BC and 6,000 BC. Still others would estimate its duration between 10,000 B.C. and 8,000 B.C. and some would even deny the existence of such a discrete transition period in context of the ancient history of Pakistan or South Asia altogether. They would like to see this technological period merely as an extention of the Upper Paleolithic. This diversity of opinion largely stems from the type of evidence one values most or one chooses to look at: some would put more emphasis on anthropological considerations while some would rely more on technological evidence. Notwithstanding the choice of the evidence type, there is no doubt that a time differential between region to region did exist.

Conclusion: The time period that has been assigned to the transition from the Stone Age existence of hunting, scavenging, and gathering to a semblance of settle life and of food production differs from region to region. It depends how we define the Mesolithic period - in terms of gross climatic changes orthose of the subsistence economics, on the basis of tool types, or simply demarcated time between the end of the Pleistocene and the onset of the Holocene, or that between the predominantly hunting-gathering activities on one hand and the practice of agriculture and animal domestication on the other.

VII.3. Mesolithic Transition in Pakistan and the Borderlands



In this chapter we briefly review the evidence of the transition from huntergathering groups of the Upper Paleolithic to the pre-agriculture

settled agricultural life in Pakistan and relate it to the climatic changes which were occurring at the close of the last ice age. We shall also review the lithic industry of this period in general and describe the stone artifacts found in Sindh, the coastal Baluchistan, and the Peshawar Valley. The relationship of Mesolithic communities to their Paleolithic forebears in regard to stone technology and many other aspects of life are questions that South Asian prehistory is now beginning to tackle and we shall attempt to address this topic as best as it can be done in the face of an abject scarcity of relevant data. The material covered in this chapter is Pakistan-specific but it borrows some introductory material from the foregoing chapters. A certain degree of repetition is therefore unavoidable.

As noted previously, there is no evidence for an isolated hunter-gatherers community in any part of Pakistan, Iran and Afghanistan that can provide a basis for the study of prehistoric huntergatherers' cultures in this part of the world. The situation in India is somewhat more amenable to such studies but these studies cannot be used here because of the radical differences in the two environments and the resulting subsistence strategies: one is largely tropical, the other is largely desertic. There is also a wide chronological gap: the data from India pertains to a much later calender time than that discussed here. Our clues must, therefore, come from other instances, most notably from South-West Asia, augmented by a rich record of the microlithic tools that we find strewn all over Sindh, southern Baluchistan and the Peshawar Valley.

Microliths, the hallmark of the postpaleolithic and pre-agriculture period, are found all over the country, starting from as early as 20,000 years ago and lasting at some nooks and corners to perhaps as recently as the onset of the Iron Age. The Mesolthic stage in Pakistan is distinguished by vivacious technological and artistic advances, as represented by rock paintings in Chilas in the North and the Kirthar Range in the South. Early experimentations with plant and animal domestication, and adaptations to a broad spectrum of food are very strongly inferred from Mehrgarh in Baluchistan.

As we look at the Mesolithic transition in Pakistan, our focus changes from the North to the South. The story of the transition from the Paleolithic to the Neolithic is, therefore, primarily a story of the South, that is, the slopes of the Kirthar range and the watered valleys of northern Baluchistan, together with the fringes of the Thar in Sindh, the banks of various rivers in Lasbela, and the coastal areas of Sindh and south-eastern Baluchistan. The northern areas do not vanish from our sight altogether but they do fade away into the mist of the Peshawar Valley and the rock shelters of Mardan and Bajaur regions.

It must be noted from the outset that a culturally defined Mesolithic period has not been traced

anywhere in Pakistan, India, or Afghanistan with any degree of archaeological certainty and there is no direct evidence of change in subsistence regime or the pattern of living style at any site that is presumed to be the Mesolithic. Still, the record in Baluchistan, at least at Mehrgarh at the Bolan River and Kili Gul Muhammad near Quetta, shows that the beginning of the ‘primary village communities ‘ was the norm throughout Baluchistan at the beginning of the Holocene and we must assume that these vibrant communities did not evolve in a vacuum. Their basis must be the corresponding communities of Paleolithic inhabitants in the same regions. Thus, while there is no discrete archaeological evidence linking the Paleolithic to the Neolithic, we would not be amiss if we assume that the stone artifacts found at very early Neolithic settlements are a continuum of the Paleolithic technologies which most likely passed through a transitory period, resembling the Mesolithic of Europe or West Asian Epi-Paleolithic primarily recognizable by the presence of the microliths.

Baluchistan, where the earliest human agricultural settlements have been found so far, has revealed no settlement that arose without the presence of agriculture or attributable to the Mesolithic or Epi-Paleolithic culture alone in this region. The residents of the earliest part of Mehrgarh in the Kachi plains on the border of Sindh and Baluchistan were already farmers, although without any pottery. Such was also the case at Kili Gul Mohammad in the Quetta Valley. There is also no evidence of sedentary living without agriculture in Afghanistan. But, it does not mean that sedentary communities did not or could not exist in this relatively dry region without agriculture or animal herding. Examples of sedentary communities in areas of limited vegetation are available in other parts of the world. For instance, archaeologists have examined the aceramic fisher-hunters of prehistoric Oman, and the presence of pit houses, deep wells, clusters of stone structures and intra-site spatial organization have been sited for Libyan Sahara. Taking the example of the American non-agricultural settlements, abundantly cited in archaeological literature, one can build a case for fixed settlement without agriculture and pottery on the basis of harvesting the abundance of seed-bearing grasses, such as wild barley, and hunting of wild sheep and goats which were aplenty in these areas.

Notwithstanding the absence of archaeological evidence beyond some changes in tool types, one must still face the intuitive anticipation of a transitional stage that connects the Paleolithic hunting-gathering subsistence to the Neolithic agricultural-pastoralist economy, no matter what the nature and course of such a transition. It could consist of a long-drawn and progressively advancing incipient agriculture or slowly changing Paleolithic hunting-gathering practices to basic pastoral activities. Most likely, both of these processes took place, the former being predominant in one region and the latter in another.

In the preceding chapter of this section, we have collectively termed this tie as a period a transition, the technical component of which is the Mesolithic. We can also look at this stage as the tail end of the Upper Paleolithic, a stage of Epipaleolithic like that defined in West Asia.This stage of human development in Pakistan has been assigned a time period between 15,000 B.C. to 7,000 B.C. in the South and between 8,000 to 4,000 B.C. in the North. Nominally, some would like to bracket it between 12,000 BC and 9,000 BC, and some would even deny the existence of such a discrete transition period in context of the paleolithic history of of the region. This diversity of opinion largely stems from the type of evidence one values most or one chooses to look at: some would put more emphasis on anthropological considerations while some would rely more on technological evidence. Notwithstanding the choice of the evidence type, there is no doubt a transitional time exists that connects the Upper Paleolithic to the Neolithic. This transitional stage is not uniform all over the country; a differential exists between region to region and this differential may be the result of man’s

adaptations to differentially changed ecological conditions associated with the retreat of glaciers and the growth of forests in the north and the disappearance of the large game in the south. Chronologically, we must look at this stage as a continuum of the Paleolithic that nominally marked its end with the advent of the Neolithic. No hard and fast dating for the beginning or the end can be ascribed and no fixed duration of this stage is possible to be determined.

It appears that at the onset of the Holocene, human beings in the Greater Indus Valley confronted the changed climatic conditions in two alternative ways. In the first instance, they intensified their techniques of food gathering, hunting and fishing through the use of their much improved stone and bone tools. In the second instance, they adapted to the changed climate by creating favorable conditions for the growth of some grain bearing grasses and encouraging some wild animals to reproduce more actively and graze in their vicinity. The societies that adapted the former fashion came to represent the communities with prolonged mesolithic cultures, some of which lingered on into modern times. Those who reacted in the latter fashion, rapidly moved on to the Neolithic without going through a prolonged mesolithic transition.

The people of Ancient Pakistan seem to represent both types of adaptations. For instance, the hunter-gatherers of northern Baluchistan entered the age of agriculture and fixed settlements quite early on without going through a prolonged or even a discernible stage of the Mesolithic huntinggathering. At least, this is what we assume in the absence of any current evidence for the existence of any Mesolithic site discovered in this area. On the other hand, the hunter-gatherers of Sindh, or those who inhabited on the fringes of the Thar adapted by sharpening their hunting and gathering skills. These communities of hunters and gatherers, armed with sophisticated stone and bone tools, continued to extract their living from the wild for a long time to come. Eventually, all the Mesolithic cultures were taken over by the Neolithic through diffusion, through human migration, or through internal developments.

Mesolithic, a Continuation of the Paleolithic and a Precursor of the Neolithic: That the microlith industry of Pakistan is rooted in the preceding phase of the Upper Paleolithic industries is proven by the continuation of the archaeological stratigraphy from the Upper Paleolithic into the Microlithic and the development of the latter category of tools from the former category. If this premises is accepted, and there is no reason to dispute it, then the end of the late Paleolithic cannot be tied to the beginning of the Neolithic phase. It apparently continued on to the Mesolithic and even to the Neolithic. In this sense, the Mesolithic, and Neolithic industries of Pakistan represent a continuum of the development processes of the Paleolithic, in the same way as the Paleolithic, and Neolithic of West Asia.

The continuity of the Upper Paleolithic industry into the Mesolitic in Pakistan as well as in the borderlands has another important corollary. The demarcation line of cultural differentiation between Pakistan and the Central and Peninsular India, initiated in the Middle Paleolithic and strengthened in the Upper Paleolithic, must have been fortified during the Mesolithic Transition. The evidence to the fact that it was indeed the case does not come directly from examining the stone artifacts of the time but indirectly when we start examining the developmental areas of the Neolithic, a stage that followed the Mesolithic. Here, the differences between the two regions become glaring indeed. While the area west of the oft-quoted separation line connecting the Indo-Gangetic divide and Kathiawar, vigorously develops into an area of genuinely agricultural communities and pastoral camps, the area east of the line, that is India, remains almost wholly hunter-gatherers and nomadic pastoralist for thousands of

years to come.



Early Holocene landscape in Baluchistan and Sindh was probably not much different from this picture - a lot of vegetation to extract one's subsistence.

The Mesolithic stage of human development, as explained in the above, gave way to the Neolithic, a stage of development when ground stone tools and pottery appeared, the domestication of plants and animals was undertaken, and man started to live in permanent or semi-permanent settlements. As we learn more about prehistoric human life, it is becoming clear that there were many parts of the world where the initial appearance of domesticated plants and animals was uncorrelated with the particular types of material culture, or permanent settlements occurred without the development of agriculture and animal domestication. The latter has been the case particularly with a major part of the present day India and probably in the coastal regions and marshy lands of Sind.

The European concept of a Mesolithic cultural tradition forming a link within an assumed progression of cultural stages has been largely accepted by interpreters of the South Asian archaeological data. Recent studies, however, demonstrate that the European definition of the Mesolithic through the typology of stone artifacts often fails to explain the transition from the Stone Age to settled life and from food gathering to food producing societies in South Asia in general and

India and Pakistan in particular.

A culturally defined Mesolithic period, as defined in European context, has not been traced anywhere in India or Pakistan with any archaeological certainty. On the other hand, the record in Pakistan shows that the beginning of the 'primary village communities' was the norm throughout Baluchistan at the beginning of the Holocene and we must assume that these vibrant communities evolved from the corresponding communities of Paleolithic inhabitants in the same regions. Thus, although there may not be a discrete period in sight linking the Paleolithic to the Neolithic, we would not be amiss, if we assume that the stone artifacts found at very early Neolithic settlements or in late Paleolithic contexts represent a continuum which could be a transitory stage that resembles the Mesolithic of Europe. Such an assumption is also intuitive in the sense that a transition period must have existed that connected the later part of the Stone Age to the beginning of farming and pastoral communities.

Indeed, there is archaeological evidence that with amelioration in climate and increase in humidity, hunter-gatherer communities spread rapidly all over the country, colonizing many areas that were hitherto unoccupied or deserted. They occupied cave and rock shelters in the mountainous areas in the North, spread over the Kirthar Range, established fishing spots on the coast of Baluchistan, traversed through the sandy plains of Sindh, camped on the fossil dunes of Cholistan, made use of the chert outcrops in Rohri Hills, and rested on the banks of the oxbow lakes of the Indus plains. This we know primarily from the microliths that have been found scattered all around Pakistan. The details of cultural change are missing. To fill this gap, we take advantage of the extensive research which has been conducted in the Near East. The inferences taken from one region and applied to anther region is fraught with false conclusions but when used judiciously they can be of considerable value.

The time period that has been assigned to this transition from the Stone Age existence of hunting, scavenging, and gathering to a semblance of settle life and of food production differs from region to region. It depends how we define the Mesolithic period - in terms of gross climatic changes or those of the subsistence economics rather than tool types, i.e., the time period between the end of the Pleistocene and the onset of the Holocene or that between the predominantly hunting-gathering activities on one hand and the practice of agriculture and animal domestication on the other.

While the presence of microliths at the beginning of the Holocene is ubiquitous at many places in Pakistan, there is no evidence of change in subsistence regime or the pattern of living style at these places. For example, there is absolutely no indication of a cultural movement from huntinggathering bands towards a semblance of settled life in any 'mesolithic' or late Paleolithic site in Sindh. Would these sites qualified to be called Mesolithic? Biagi and other researchers, working in this area, are prone to call these sites mesolithic on the basis of typology coupled with some tell-tale evidence indicating the beginning of settled life or extended of now dried-up lakes. We are, however, on firmer ground in the Peshawar Valley (Shanghai Caves) and the Kachi plains (Mehrgarh). These sites do conform with the commonly understood concept of the Mesolithic - microliths, beginning of settled life or at least decreased mobility, food gathering coupled with food storage, some semblance of social organization, etc.

If the picture of the earliest emergence of microliths is slowly falling into place in Pakistan and the borderlands, there is no such clarity about their last limits.They certainly occur widely till the Bronze or even Iron Age levels, which is not an uncommon situation even in some regions of Europe. Their presence even up to the urban period has already been mentioned. This should not, however, disturb

us in our analysis because we are discussing this period largely in terms of culture rather than technology. In this respect, we can safely assume that this phase came to a gradual end as the agricultural cultures slowly phased in.

Population Growth and Demographic Changes: An important feature of the Mesolithic period was the significant growth in population. This is evident from the fact that sites of this period are much larger in number than those of the preceding Paleolithic stage. Interestingly, this growth in population has been universal and it seems to be connected with favorable climatic conditions and a resulting increase in food supply. The evidence for this is provided by the pollen data from the salt lakes of the Thar Desert, deep weathering of sand dunes in Cholistan and the analysis of ocean cores from the Indus Delta, cited earlier.

In addition to a general increase in population throughout the region, major changes in regional demography occurred. It has been shown previously that the time period covered under the Upper Paleolithic was marked by extreme cold in the North and a prolonged period of dry climate in the South. The ice sheet covering the northern hemisphere and the glaciers populating the Himalayan foothillls had sucked up tremendous amounts of moisture from the atmosphere which caused a severe decrease in rainfall and a marked decrease in sea levels. Under these climatic conditions, the deserts expanded and became inhospitable to humans. In South Asia, the Thar Desert was to a large extent depopulated except on its fringes where some water could be had all the year round. Examples of these sites are the Rohri Hills, the Ongar near Hyderabad, the shores of the various lakes, such as the Manchar Lake, and areas along some of the natural springs in the Sind Kohistan.

As the Pleistocene approached its end, it was but natural that an impressive increase in population first occurred in areas of higher population density, such as the fringes of the Thar and the banks of small rivers feeding the Indus from its western basin. The northern areas took considerable time to repopulate and join the march to the Neolithic. Of especial interest to us are the recolonization of the Thar Desert, the inhabitation of the Cholistan Desert, and a rapid but belated increase in settlement density in the North. The indigenous population in the dry zone expanded rapidly and recolonized the Thar Desert wherever it was hospitable. It is very well possible that some ‘foreign’ population groups also moved in to take part in this recolonization.

It is during this period that humans extended their habitat into the alluvial plains between the Indus and the Hakra in a significant way. M.R. Mughal discovered hundreds of Mesolithic sites in Cholistan and Biagi discovered several sites around lakes (now salty) in the Lower as well as Upper Sind. In Cholistan, which is extensively covered by fossil sand dunes, Mesolithic artifacts are present virtually on every one of the thou- sands of dunes. A significant fact is that the increased human presence in these regions represents a re- colonization after a long period of human’s depopulation in the dry period in the Later half of the Middle Pleis- tocene.

It is suggested that greater availability of food and better health of the people were probably the main factors which led to decrease in mortality rate and the increase in population. While better rainfall in Holocene age contributed to greater plant growth as well as increase in fish and animal population, the use of microliths as arrows or spearheads greatly improved the hunting efficiency of the Mesolithic man. The evidence of querns and mullers which appear for the first time in this period further confirms that plant food was supple- menting the animal diet. Thus, assured of better food supply, the Mesolithic man led a healthier and a longer life.

At the risk of generalization, during the Late Upper Paleolithic or early Mesolithic, ca. 10,000 to 15,000 years ago, human populations had spread into most of the habitable regions of Pakistan where water was available from river streams or natural springs and game was to be had aplenty. With the aid of their flexible hunting and gathering techniques and rapidly evolving tool-making technology, these groups, loosely organized as small bands of hunters and gatherers, were able to adapt to virtually all the climatic zones and environmental niches in the region, from the arid zone of Cholistan to the temperate climate of western foothills, to the cold climate of Swat and Kashmir, to the hot and dry valleys of Baluchistan, to the plains of rivers in Punjab, and to the coastal regions in the south.

Microliths: The lithic technology of the Epipaleolithic or Mesolithic stage in Pakistan has come to be defined in terms of microliths, and that too in European terms. This tool tradition has been amply described in the foregoing chapter of this Section. Here we touch upon a few microlith traditions that are specific to Pakistan and to the surround areas. These findings most likely belong to the later part of the Upper Paleolithic, to the early part of the Neolithic, or to the duration in between.

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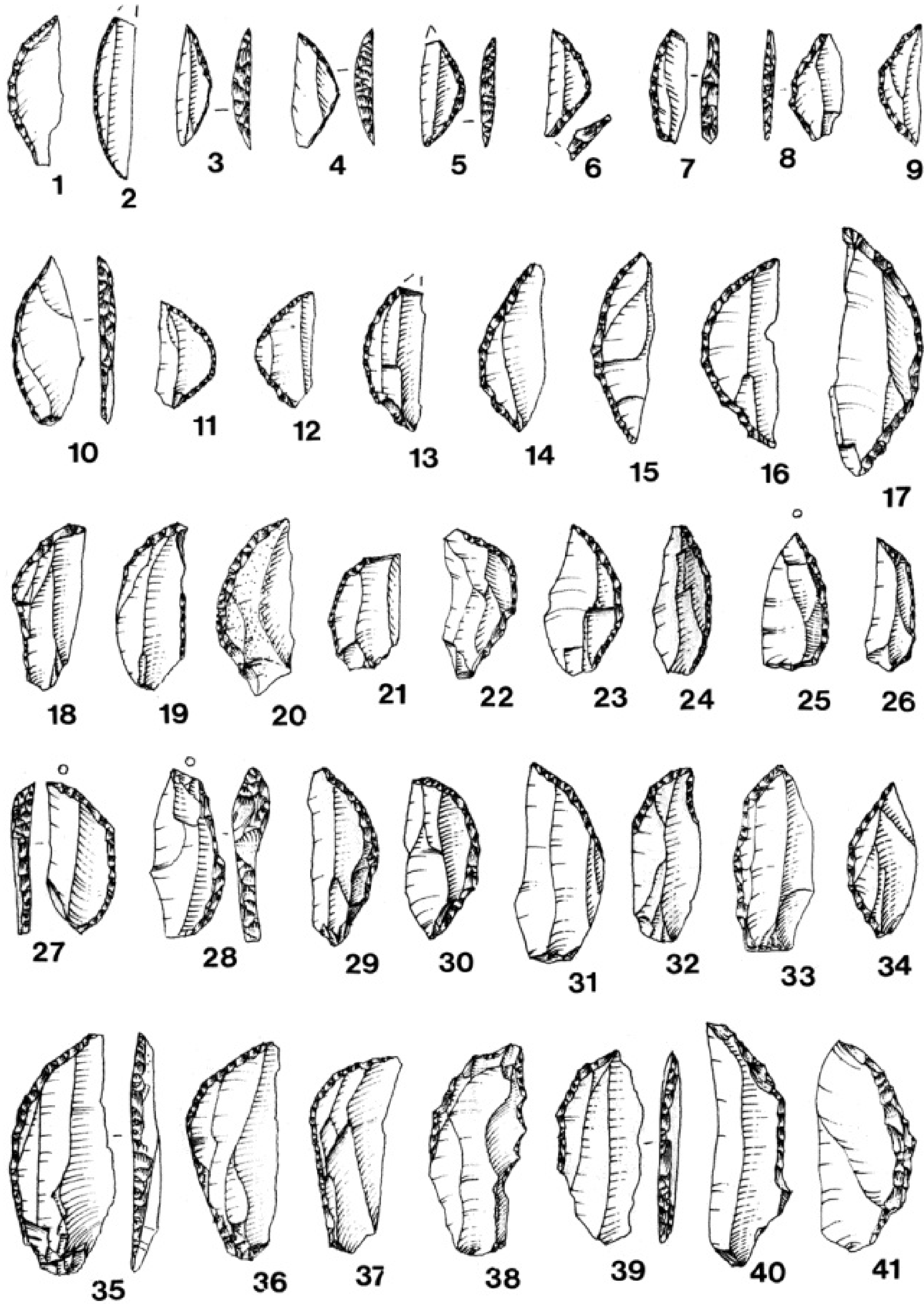
This chronological underpinning of our discussion, however, does not stem from any absolute dating but rather is the result of an intuitive faith. The Epipaleolithic lithic technology guide.

We in West Asia is our

do not propose to abandon the mesolithic phase altogether but also do not propose to use it as a holdall in which chronologically uncertain evidence of microliths and evidently copper and iron related evidence of these tools can all be put together with those sites which fall indisputably towards the end of the Pleistocene and in the early part of the Holocene. It must also have cultural context. Unfortunately, most of the In*!"#$#%&'()'%*dian archaeologists have

Examples of geometric %microliths, samples collected by Biagi from around the lakes Khat Sim and Sain Sim, upper Sindh.

not taken necessity. there is a small tool, it must be mesolithic.
Microliths are found all care of this For them: if



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"## over Pakistan with the apparent exception of the extreme north. A large number of sites are found in the Thar Desert as well as in upper Sindh. A few sites with microlithic tools such as crescents, lunates, trapezoids, micro-blades and the like have been found in lower Sindh as well as in Las Bela and Makran along the coast and in Cholistan Desert which is essentially an extension of the Great Indian Desert, the Thar, but none have been excavated and dated. Bridget Allchin testifies to the presence of similar micolithic tools in the area of Karachi Golf Course before the area was built up. The Late Paleolithic and Mesolithic sites found by Rauf Khan! coastal Mesolithic period is quite evident and it seemed to last quite a long time. At some other sites, such as those in the plains of Las Bela and Kachi, we do find some indications of the Mesolithic but it appears to be rather short-lived. At most of the known population centers, such as Amir and Kot Diji, however, no evidence of Mesolithic tool assemblage is at hand. It appears that in these regions, the huntergatherers of Paleolithic period suddenly learnt the domestication of animals and plants without going through a prolonged period of cultural transition. The elementary settlements seem to appear without a transition from the nomadic lifestyle. The same pattern seems to be prevalent in Afghanistan where a few Mesolithic sites have been discovered which are chronologically comparable with those of Mehrgarh. In South India, where most of the research work has been undertaken in South Asia, on the other hand, the Mesolithic period was much prolonged and diverse; it started late and it also ended quite late.

As stated previously, most of the microliths, because of their small sizes, could not have served as individual tools. These implements were most likely used as components of compound tools, such as spearheads, arrowheads, knives, sickles, harpoons and daggers. They were probably fitted into grooves in bone, wood and reed shafts and joined together by natural adhesives like gum and resin. Actual specimens of such implements have been found in suitably preserved archaeological situations in many parts of the world. In Pakistan, one primary example is a ‘sickle’ found at Mehrgarh where the microliths were attached to a handle with the aid of bitumen.

Apart from flake stone tools, the Mesolithic people also used other tools which included hammer sotne, perforated discs or ring stones, querns and rubbers. The hammer-stone was used, besides other things, for splitting animal bones; querns and rubbers must have been used for processing both plant and animal food. Some Mesolithic tools are of uncertain purpose, such as the perforated ring stones found in Sindh and neighboring Gujarat in India. One hypothesis is that they served as weights for digging sticks in the foraging for roots and tubers. Among such tools were sharp stone burins which rendered possible more effective manufacture of tools made from other raw materials, such as wood, bamboo, horn, ivory, bone, shell, and leather.

on the Mulri Hills, in front of Karachi University Campus, constitute one of the most important archaeological discoveries made in Sindh during the last fifty years. The last hunter-gatherers, who left abundant traces of their passage, repeatedly inhabited these hills. Some twenty different spots of flint tools were discovered during the surface surveys. Rauf Khan collected some notched microliths here, which seems specific to this area.

In some geographical areas, such as the region around Karachi, the presence of Fluted cores, scrapers, points, and chipped pebbles are other components of the mesolithic tool kit. The discovery of the Mesolithic artifacts is not confined to stone implements; a number of bone tools have also been found. These are much more complex tools than found anywhere in the reign and consist of needles, awls, and hooks. Apparently, these were used in working hides into suitable clothes or in fashioning of shelters from wool felts and hide.

If the picture of the earliest emergence of microliths in Pakistan, Afghanistan and India is slowly falling into place, there is no such clarity about their last limits. They certainly occur widely till the early Iron Age levels, which is not an uncommon situation even in Iron Age England. In certain areas, however, the use of microliths could have continued till the early medieval context. Myriads of surface clusters of microliths in the subcontinent are undated and thus cannot be put in a specifically mesolithic context.

A note of caution must be struck here. The beginning of agriculture and animal domestication, known as the Neolithic, is nominally considered the terminus of the Mesolithic or Epi-Paleolithic transition. The use of microliths and compound tools based on these microliths is the hallmark of this period. However, attempts to define the Mesolithic on the basis of the microliths alone are unlikely to be helpful and may readily by misleading. Microliths occur in abundance in Pakistan as well as in India and Afghanistan but their context is often undetermined and some are quite late.

For example, throughout the Indus system most of the microlithic industries so far recorded are associated with what appear to be permanent settlements. These include agricultural settlements of the Early Indus period as well as those of earlier periods with a less developed sedentary character. . A good example of this is the Bronze Age diminutive stone tools associated with Harappan sites, such as Allahdino near Karachi. Similarly, it is commonplace in Indian archaeology to find sites where microlithic tools are associated with copper artifacts and ceramics, such as the post-Harappan sites in Gujarat. There have been two reports from India of “microliths” made from bottle glass, which would imply that they were made fater the seventeenth century AD.

Raw Materials: Along with the miniaturization of tools, there was a change in the use of raw material. In all areas people switched over to chert, agate, jasper and other fine-grained stones. In southern Pakistan chert was the favored material which occurred in the form of nodules in the outcrops of limestone around Sukhar and Hyderabad. In the northern areas, such as the Peshawar Valley, milky quartz was easily available and it was used. In Gujarat, India, jasper seems to be more popular because of its ready availability. The pressure technique economized the precious raw materials and produced more bladets and microliths in lesser time.

We know that in the Neolithic period the chert nodules were heated to improve both workability and color. It is quite likely that this practice began during the previous pre-neolithic period, and was one of the factors that made possible the manufacture of much smaller tools from small nodules of high quality material. What the relationship was between this practice and that of heating milky quartz to facilitate shattering it, which appears to have been used in Shanghai area, is not clear at present.

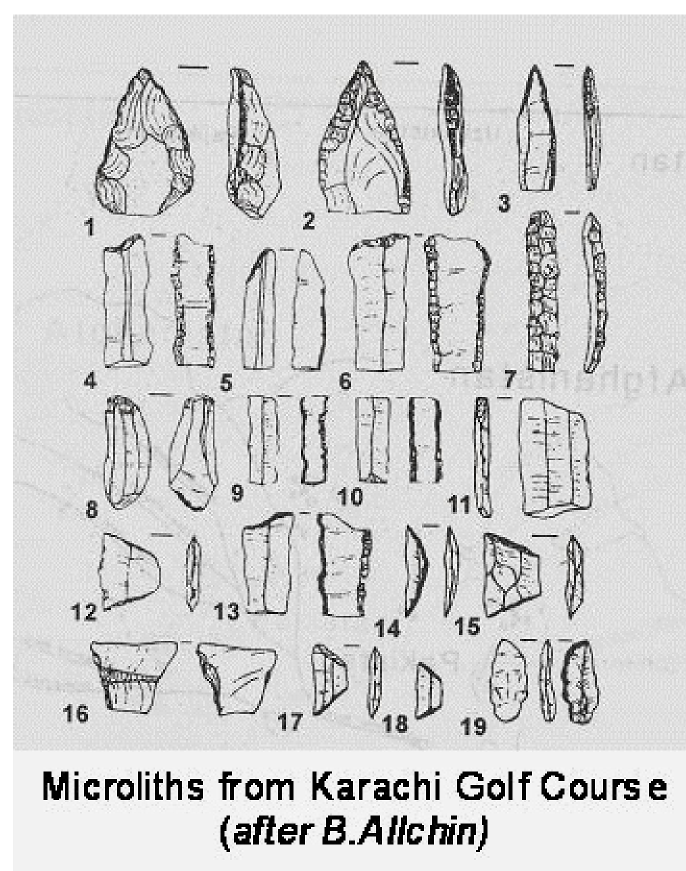
Bone is a ubiquitous material in huntergatherer societies even when other tool materials were not scarce or unavailable. Any portion of animal or fish skeletons could potentially be utilized, however antlers and long bones provide some of the best working material. Long bone fragments can be shaped, by scraping against an abrasive stone, into such items as arrow and spear points, needles,

awls, and fish hooks. As an organic material, bone often does not survive in a way that is archaeologically recoverable. However, under the right conditions, bone tools do sometimes survive and many have been recovered from locations around the world representing this time periods throughout prehistory. No bone tools, belonging to the Mesoilithic period have been discovered in Pakistan. In India, only one site has been reported to have contained such tools but its temporal horizon is not known.

The non-lithic raw materials such as for making twine from vines, tall grasses and gut, upright structures supported by poles, animal traps, and a wide variety of objects relevant to social and religious practices has been indicated in diverse rock paintings in the Northern Areas of Pakistan, and the archaeological record from Sanghao Cave. But such a conclusion is open to question based only on the local evidence. It has, however, a sound basis if derived from the diverse evidence collected around the world. It is clear that the perishable nature of nonlithic tools possibly made by mesolithic peoples means that we hold a narrow view of their technology.

Mesolithic sites in Pakistan: Pre-Neolithic settlement of Pakistan has not been researched to any great extent. The earliest settlements that have so far come to light are those that have been reported by Jarrige from Mehrgarh in north-eastern Baluchistan. But, these people were already agriculturists and thus belong to the Neolithic time period. Fairservis has reported a 'mesolithic' layer beneath the Harappan site of Allahdino near Karachi but no carbon dates are available. Some other stray findings in Las Bela plains and coastal Sindh have been reported but no details have been given; it is not even certain that these are in fact the mesolithic campsites.

of the



Microliths from Karachi Golf Course
(after B.Allchin)

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for later or even

ing groups, or communities partly dependent upon hunting, in many cases overlapping in time with settled agricultural and urban communities” (6).

Although the distribution of truly *mesolithic* evidence (In European sense) in Pakistan is stilI limited, the distribution of *microlithic sites* is not; in fact, it is easier to note the areas with microliths than those without them as microliths are more ubiquitous than paleoliths in the sense that they are far more visible in the landscape. An overview of the

Transition to Settled Life**!**spread of microlithic sites in Pakistan will indicate that the human communities were settled in a vari

of this

ety of environments, which included fossil sand

Mesolithic period of these regions should be viewed as a precursor of thedunes, rock shelters and also the alluvial plains of

the Lower Indus Valley where they had enough wa

of the
Neolithic rather than as an independent technological phase. In other words, weter, food resources and raw material for tools. They
may regard this whole time period as
a transitional phase from thealso extended their habitat into areas previously either totally unoccupied or occupied only sparsely.late
Paleolithic to the Neolithic, instead of a distinct developmental phase.Microlith sites are well represented in large

part of southern Pakistan, leading archaeologists to

In its broadest sense, the Mesolithic in Pakistan can be considered to begin with

infer that such a proliferation of sites relates to marked growth in human populations in this area

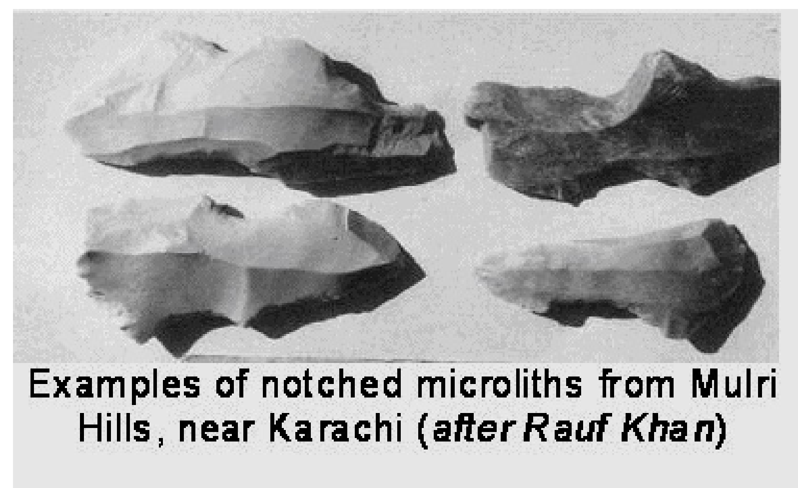
the end of the last glacial period over 10,000 – 12,000 B.C. and evolve into the during the onset of the Holocene. As stated above, Neolithic period somewhere around 8000-9,000 B.C. This change involved the

the dramatic increase in Mesolithic (in reality, microlith) sites and the presence of settlements in previ

gradual domestication of plants and animals and some semblance of settled or

ously unoccupied areas are thought to be related to the wetter climate at the beginning of the

semi-settled communities. By 7000 BC
quite evident and it seemed to last quite a long time. At some other sites, such as those in the plains of Lasbela and Kachi, we do find some clear indication of the Mesolithic but it appears to be rather short-lived. At most of Examples of notched microliths from Multi Hiils, nearthe known population centers,


Examples of notched microliths from Mulri Hills, near Karachi (*after Rauf Khan*)

Karachi (after Rauf Kha n)evidence of
Mesolithic period is at hand. It appears that in these regions,

and the resulting abundance and diversity of plants and animals. Few of these Mesolithic sites have,

this movement had already culminated

however, been excavated or properly reported. In

in effective village-farmingfact, it is only in recent years that some of these

sites in Sindh have been surveyed and published,

communities in the Kachi plains,

mainly thanks to the Italian Archaeological team,
headed by Paolo Biagi. Some of the reported sites

especially at Mehrgarh. The northern

by other researchers are from Cholistan (Bhawalpur

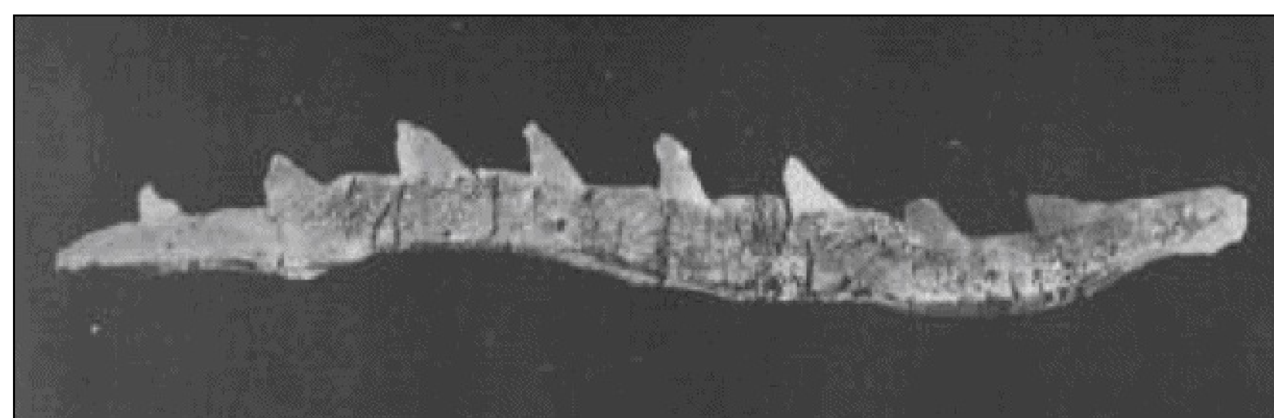
part of Bluchistan was not far behind Division) in south-eastern Punjab; coastal Sindh,

including the area around Karachi; and along the

where the same kinds of development

coastline in Las Bela. Microliths have been found in

however,
no
started to happen almost concurrently, if not somewhat earlier. Archaelogical considerations, however, compel us to the hunters-gatherers ofmaintain that in the environmentally favorable regions of southwest Asia as well as in Baluchistan little if any trace of the Mesolithic stage is visible. The general level of culture probably shifted directly from the Upper Paleolithic to that of



incipient cultivation and domestication. This virtual absence of a strongA composite tool from Mehrgarh, Baluchistan. Geometric microliths are hafted on a wooden piece and set with bitransition period — from the Paleolithic to the Neolithic — has been taken bytumen. (after Jarrige)



Page 114some archaeologist as a proof for diffusion of agricultural technology from
outside the region, probably from the Middle East.A few samples of geometric microliths from Mulri Hills, In the absence of an adequate evidence, Lower Sind

(after Rauf Khan)therefore, we can be content to echo the pro nouncement of Misra that "...the Mesolithic (in InNotwithstanding the absence of archaeological evidence beyond some changes dian subcontinent) represents a transition, lasting During the past half a century, our knowl only a few thousand years, between the Paleolithic in tool types, one must still face the intuitive anticipation of a transitional stage

and the Neolithic period" (4) or Allchin's "... The edge of the Mesolithic Pakistan has started to in crease somewhat, thanks to the discoveries made Mesolithic is a more comprehensive cultural term,

that connects the Paleolithic hunting-gathering subsistence to the Neolithic

in the Thar Desert, along the southernmostt fringes

as it designates its position in the industries of huntagricultural-pastoralist economy, no matter what the nature and course of such a the reanalysis transition has been. It could consist of 411 a long-drawn and progressively advancing incipient agriculture or slowly changing Paleolithic hunting-gathering practices to incipient pastoral activities. Most likely, both of these processes took

of the materials recovered by Todd and Paterson on the terraces of the iLari River in Karachi, and the systematic study of the assemblages collected by A. Rauf Khan on the Mulri Hills, near Karachi (8,9). But by far the most important contributions have been by Paolo Biagi and his team who have done extensive work in Sindh for more than a decade in 1990s. This work has been summarized by Biagi in a review paper (5). All of this work is, however, technological oriented and shed little light on the subsequent development of agriculture and the Neolithic cult in the Thar Desert, along the southernmosture in this region. In the following pages we shall review this work and a few others.

Mesolithic sites in the Thar and on the Fringes of the Great Desert: Microlithic sites are found in profusion in the Dry Zone, with the apparent exception of the extreme north of the Thar Desert, where they have not been recorded at all, and the Kathiawar peninsula (India) where they are comparatively rare. Also, they become progressively more sparsely distributed as one moves into the desert, but small sites continue to occur even in the most arid regions.

In the Thar Region the sand of the final arid phase provides a break between the Upper Paleolithic and Mesolithic when population density in this region decreased drastically. Following it, at the end of the Pleistocene or beginning of the Holocene, Mesolithic groups moved into the Dry Zone leaving clear evidence of their presence in the form of minor camp sites on the crests of many fossil dunes and larger factory sites near sources of good raw material and water. This was the situation in large part of Sindh and the Desert of Cholistan, both of which areas are rich in Mesolithic remains. The process must have been similar to that which took place at the end of the earlier arid phase when the makers of the Rohri Middle-Paleolithic industries swept into the region filling what must have been virtually a population vacuum. On both occasions the process must have been a progressive one, as increasing

humidity brought about improved conditions further into the Dry Zone and the interior of the Thar.

The distribution of microliths in these zones covers an extended period of time and it is difficult to assign these artifacts to any particular time. A large number of archaeological sites dating to the fifth and six millennia and continuing to early historic times in the region between the Indus and the Hakra rivers have been daited; these are situated along water courses that are today ephemeral streams or dry channels. At some sites Upper Paleolithic artifacts are also found although no stratigraphic sequence has been reported anywhere. The difference between the tools of Upper Paleolithic and Mesolithic industries is basically one of size. At several sites, there are assemblages of larger and smaller Mesolithic artifacts, and at Rohri Hills, for example, there are blade industries that appear to be transitional between the Upper Paleolithic and Mesolithic. A continuity of settlement is thus indicated.

The Sites in the Upper Sindh: Several surveys carried out by the Italian mission between 1995 and 2002 east of the former caravan town of Thari in the Thar Desert led to the discovery of a number of archaeological sites along the dunes that surround the saltlake basins of this region. This work has been summarily reported by Paolo Biagi (5). A very similar environmental landscape is that of the nearby western Rajasthan (India), where many Mesolithic sites have been discovered and partly excavated (10). The saline lakes are supposed to have formed inside depressions, which result from the blocking of drainage lines by aeolian deposition or by a decrease in discharge, which has disrupted the flow along a complete river system (11). The top of the dunes, which are presently covered with a sparse vegetation of shrubs and trees, often yield microlithic flint assemblages, which are represented by different types of geometric tools (4).

The presence of these artifacts would suggest that the Thar Desert dunes stabilized during the climatic amelioration of the beginning of the Holocene as the pollen data from the sediments of Lake Didwana (in Rajasthan) indicate. It is now widely accepted that the Mesolithic huntergatherers, with the newly developed microlithic technology probably first appeared at this time (12) . The results of the most recent studies in Upper Sindh show that around the beginning of the Holocene the lakes were very shallow, with a fluctuating water table, which abruptly began to rise during the Middle Holocene, just after the middle of the seventh millennium (13). During the 2001 and 2002 surveys by the Italian Mission, most of the sites were found along the dunes that surround the salt lakes (5,14). A few more sites were published later by Mallah *et al* (15).

Biagi et al report that all the microlithic assemblages of the Thari district are obtained from Rohri Hills flint, the nearest outcrops of which are located some 5 km east of Khat Sim. The industries show some typological and dimensional differences, even in the types of the geometric tools. The trapezoidal arrowheads, which are, in most cases, of an isosceles shape and variable dimensions, are particularly important. These tools indicate that of an isosceles shape and variable dimensions, are particularly important. These tools indicate that many of the sites were inhabited during the Late Mesolithic.

The sites of Lower Sindh: The discovery of microlithic tools in Lower Sindh was reported for the first time by Todd and Paterson, who collected a few flint artifacts from the banks of the Lyari River, now a part of northeast Karachi. Apart from this assemblage which includes a few geometric tools, the most important discoveries were made by Prof. A. Rauf Khan (8) on the Mulri Hills just south of the Karachi University Campus. These hills, which cover an area of some 7 square miles, are now

highly urbanized and lost to archaeological research.

The hill is crossed by two main series of faults, which run in an east–west and northwest–southeast direction, along which a few springs open. They are probably one of the main reasons for the prehistoric settlement of the area. According to the field notes of Prof. Rauf Khan, most of the sites were located along the faults, often close to freshwater springs. Some of the prehistoric sites of the Mulri Hills are distributed along the slopes of the hills. They seem to indicate different periods of oc



cupation. All the assemblages were obtained almost located even now within this belt, and support many exclusively from small flint pebbles of various colof the existing settlements. There are indications of ors, whose outcrops are still unknown. Rauf Khan%&'&! ()*+,)-.+'&!many more springs within it which have now ceased!A'58)827! .5! 8&! 45+61.!)25*6! .1&! 45+.1&'*! suggests that they might have been collected from 2361.! 7&225%341! 8'5%*! -525+'! 9":;<! =>?@?! ,'3*6&4!5,!.1&!<51'3!C3224/!

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Khan is unknown. More sites were found further to the south, at Rehri for instance, along the terrace which lies in front of the mangrove swamp of Kadiro Creek. Other finds come from the right bank of Ran Pethani, which flows straight through the Salt lakes to the Arabian Sea a few kilometers east of Rehri.

A few more scatters of flints were recovered west of Karachi, close to the village of Mendiari, west of the of the Khirthar Range. They come from the terraces of the Hab River, which after forming the western boundary of southern Sind, falls into the sea west of Cape Monze. Rauf Khan observed that the sandstone outcrop just right of Cape Monze “is a good quality aquifer and dozens of springs are

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Saline lake basins in upper Sindh where the Mesolithic ?
settlements have been found (5)

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! Other important discoveries were made a"#$few kilometres northeast of Karachi, along the!

banks of the streams that flow into the Malir River, more precisely, from west to east, the courses of the Khonkar, Thaddo, Langheji, Mol and Khadeji. Unfortunately, the exact location of most of the sites found during the surveys carried out by A. Rauf


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The Salt Lakes district of the Thar Desert in upper Sindh,

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where a number of mesolithic settlements have been found

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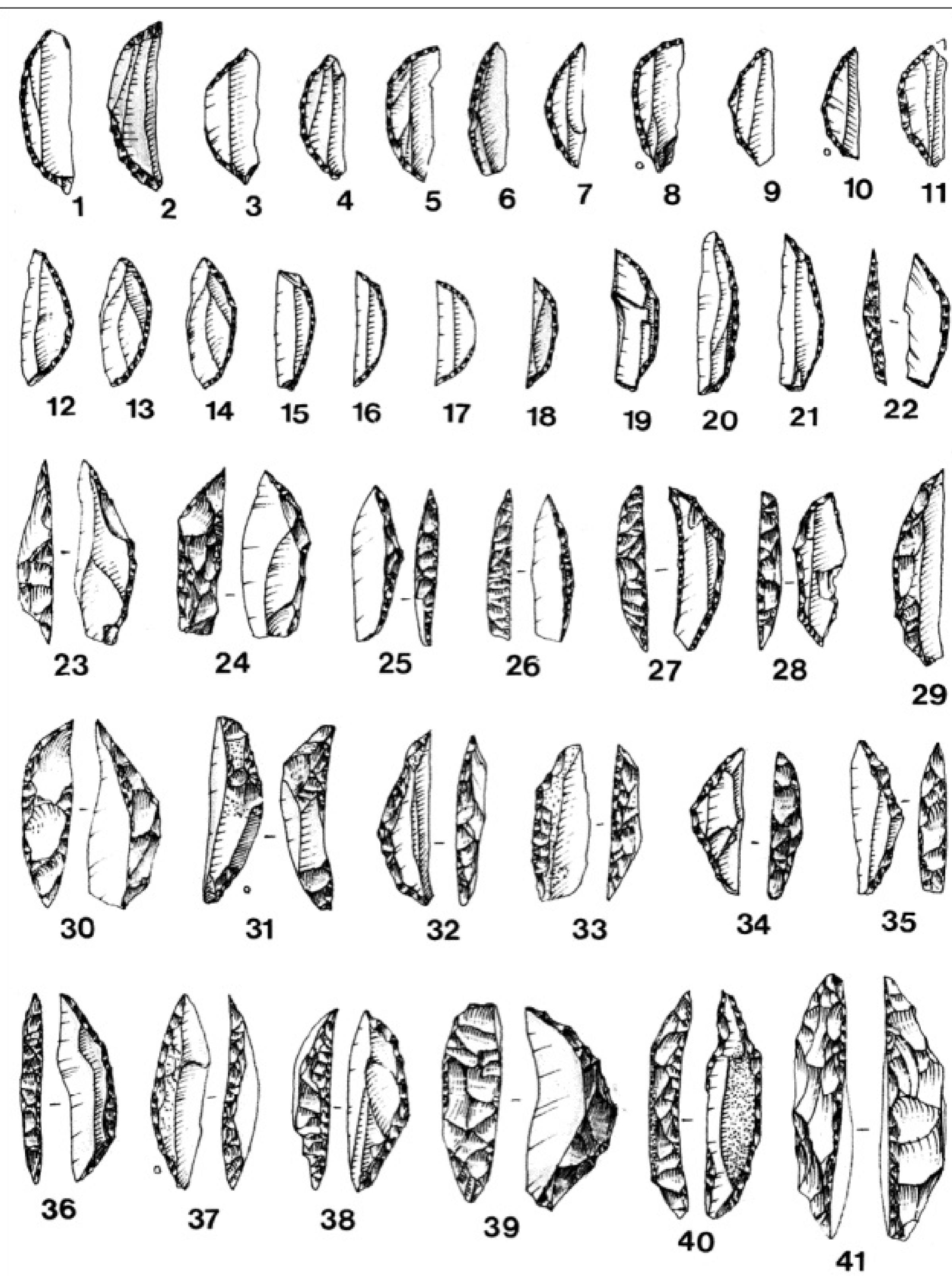
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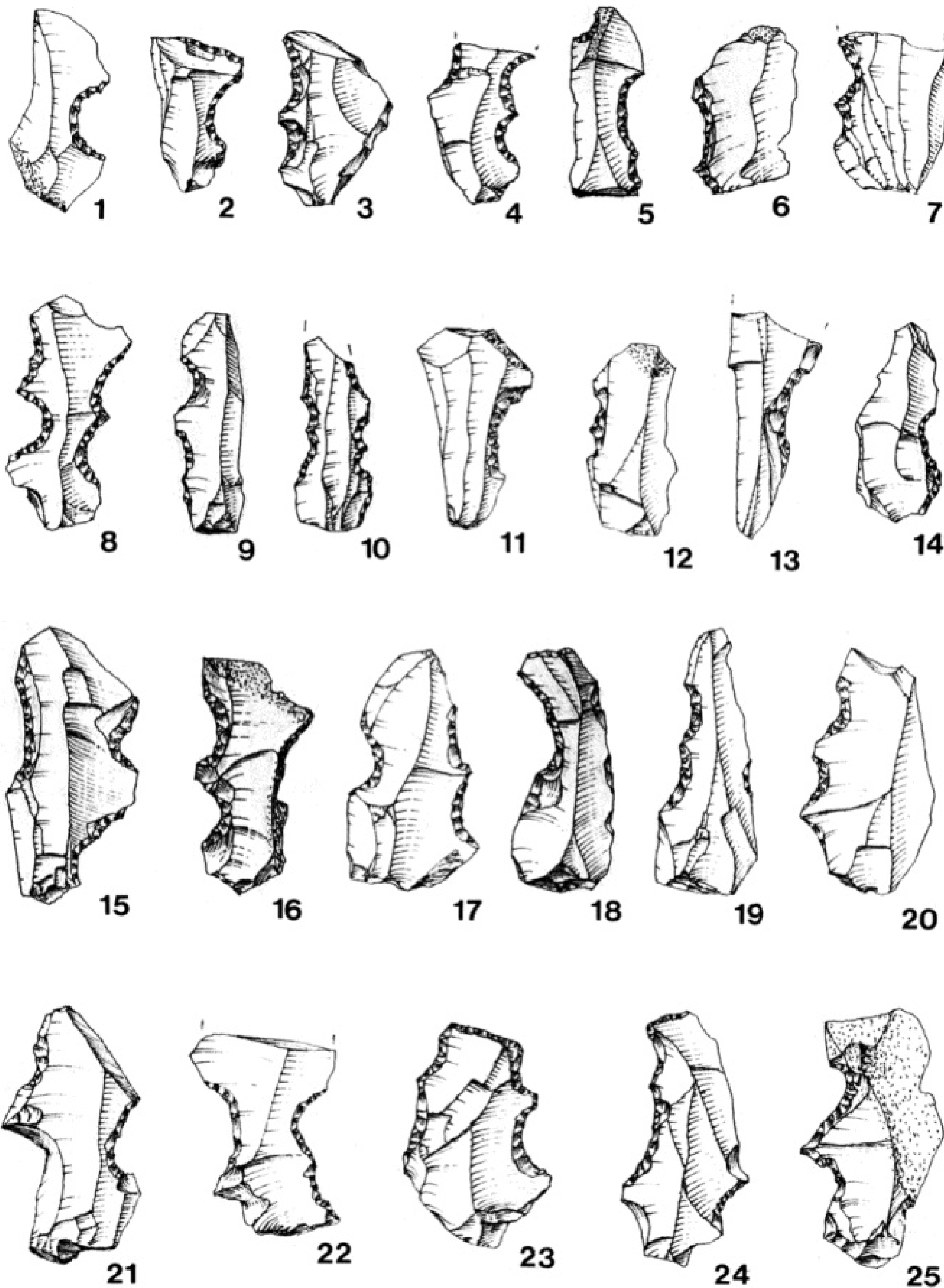
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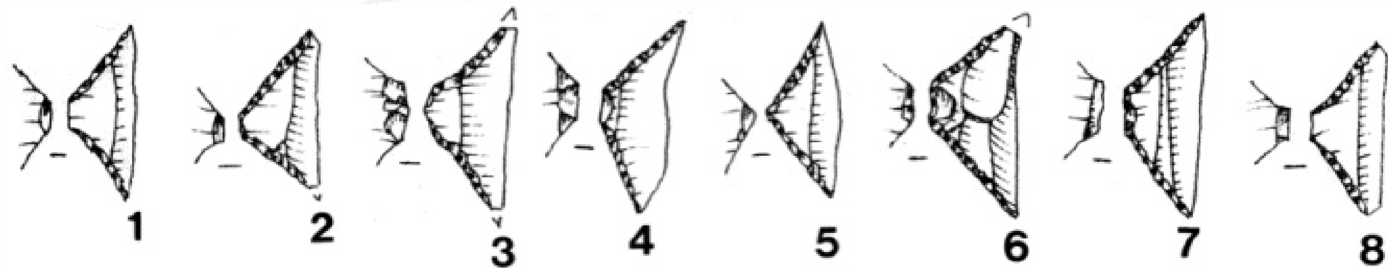
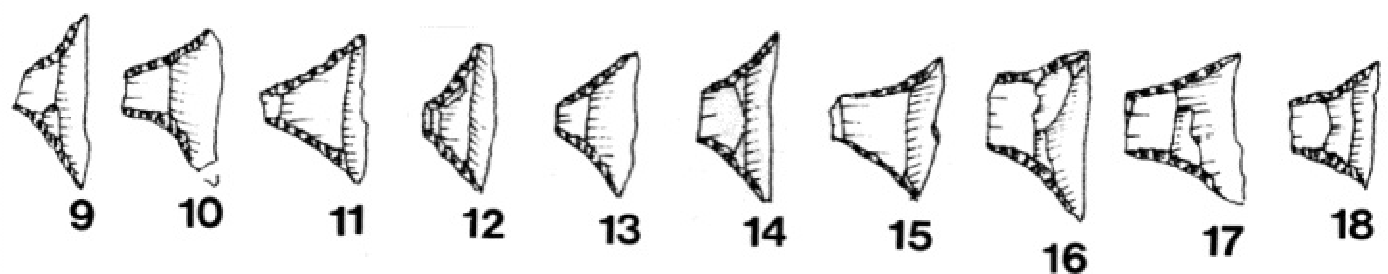
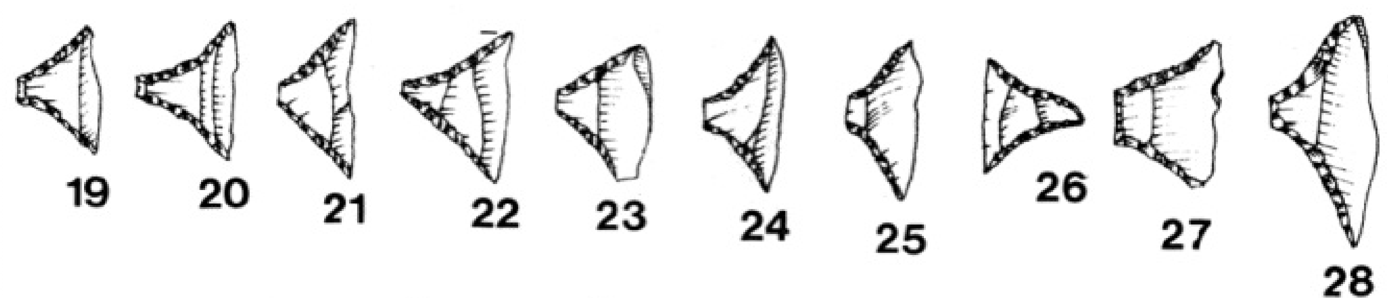
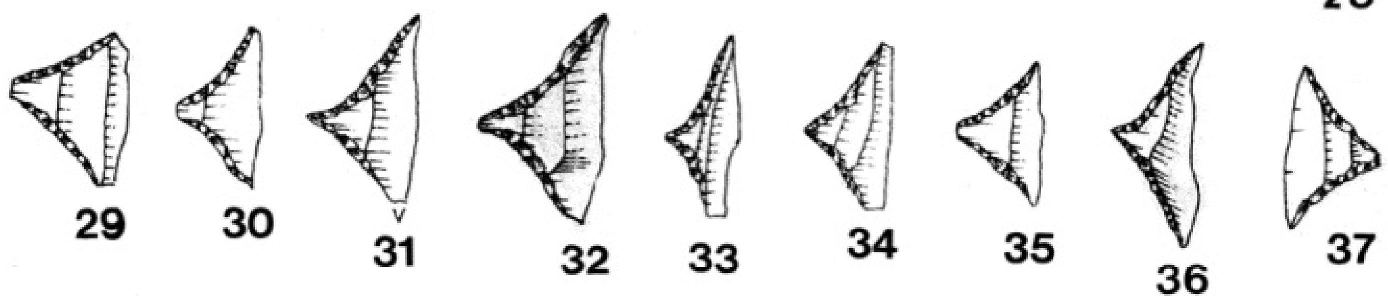
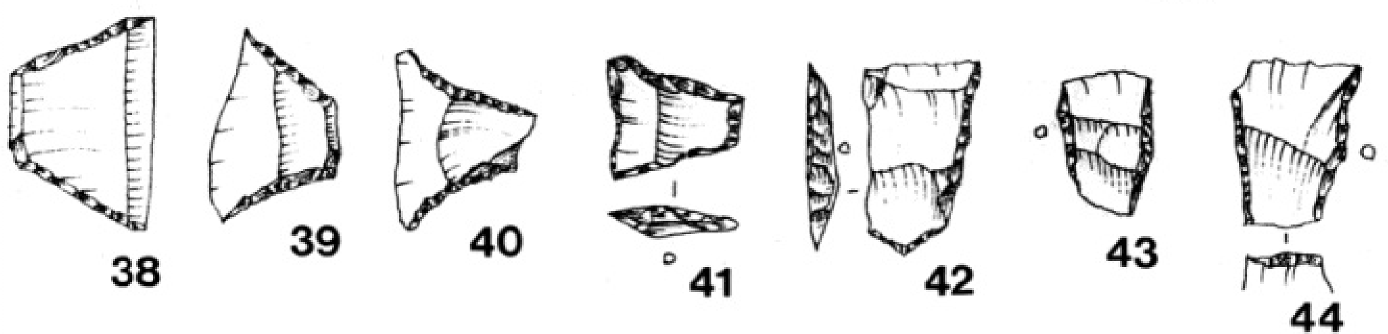
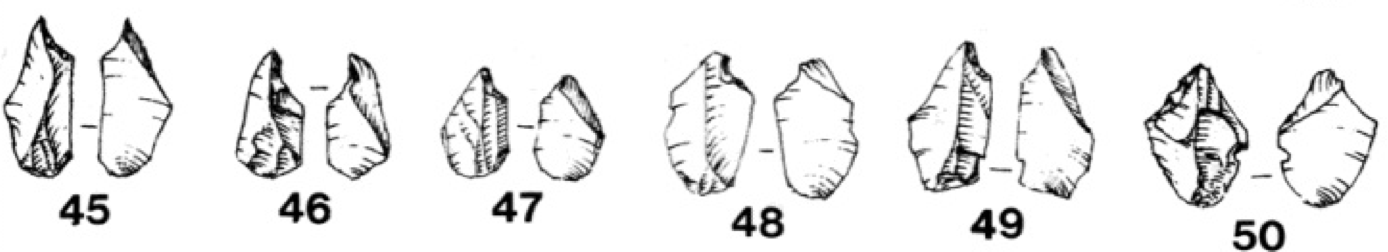
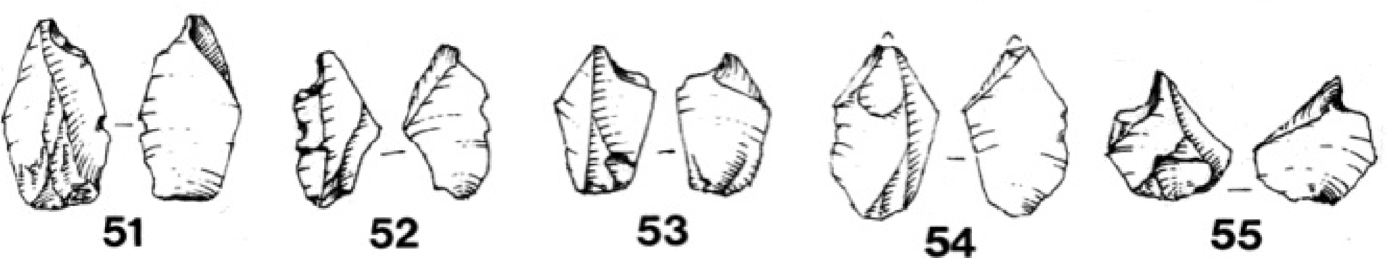
to flow or have brackish or salt". According to Biagi, ! D525+'4!5,!.1&!E+*4&22!F532!D525'!D1)'.4!G:::/! most of the Mesolithic sites of this area are characterized by microlithic lunates, although many isosceles trapezoidal arrowheads are common to some of them, while others, which are supposed to belong to the end of the Late Paleolithic, are represented by curved backed points obtained with an abrupt, deep, bipolar retouch.

The degree of mobility for these groups is debated, though they appear to have been semisedentary as judged by auxiliary evidence from elsewhere. The increased food supply available in the Mesolithic is thought to have led to a reduction in mobility, as reflected in the large size of sites, and the appearance of more substantial habitation deposits. All of the prehistoric sites discovered between the end of the sixties and the beginning of the seventies have been totally destroyed. Many sites that have been mapped in the Lower Indus Valley occur adjacent to oxbow lakes.

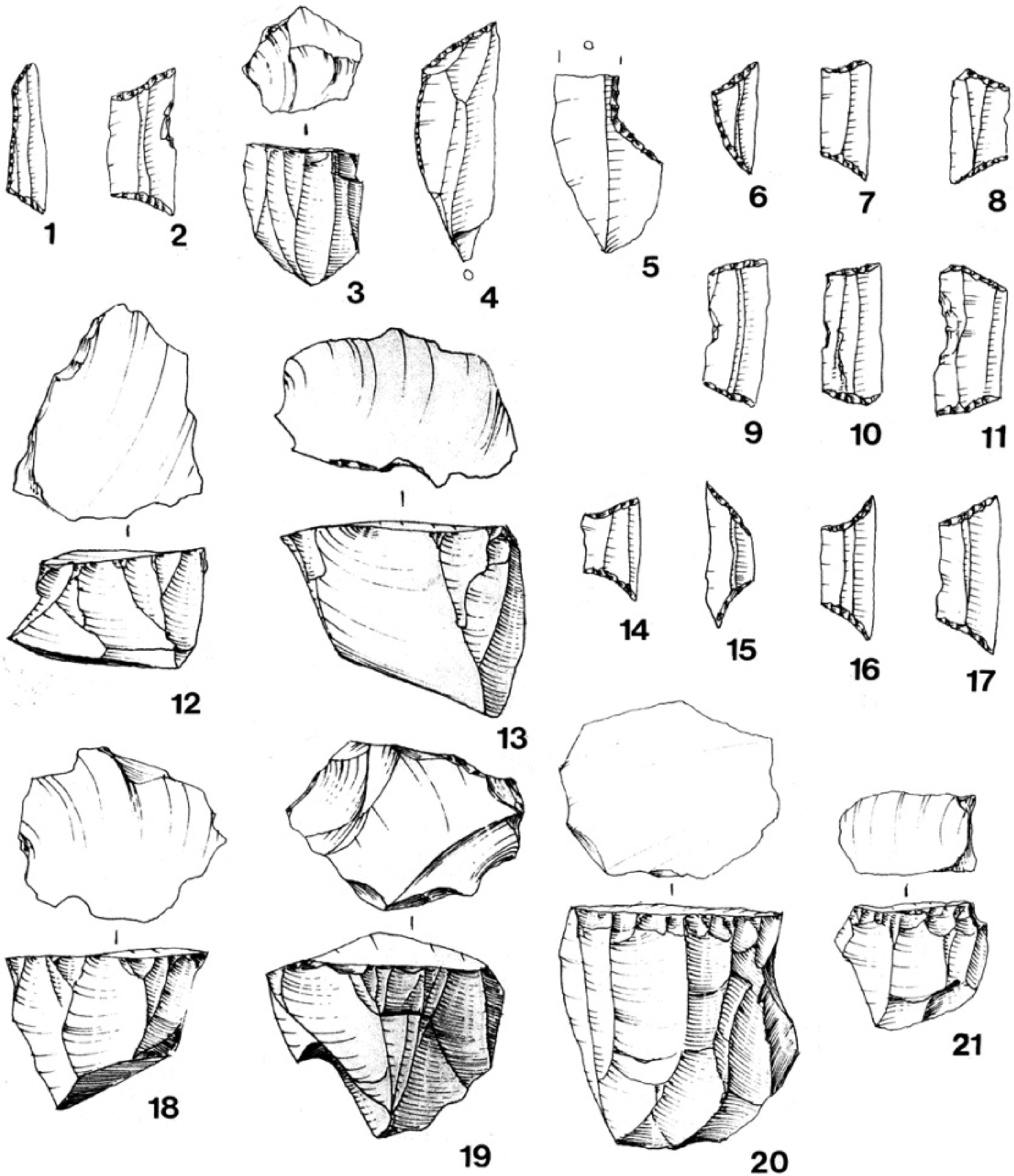




Different types of stone artifacts from the lower Sindh Upper: Lunates, Middle: Geometrics, Bottom: Denticulates


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Other Sites in the Dry Zone: All the sites of Upper Sindh have been discovered in a very limited territory rich in salt-lakes. They are located very close to the flint outcrops of the Rohri Hills. All the sites which are characterized by scatters of flint artifacts lie on the top of stabilized dunes that surround the lakes. Many of these sites yielded a few geometric tools, whoich, in most cases, are represented by isosceles trapezes, with oblique, straight truncations, obtained from bladelets: their dimension varies site by site. The occurrence of these tools suggests that the encampments were temporarily settled during an advanced period of the Mesolithic, most probably for hunting purposes. The presence of cores, debitage flakes and waste pieces indicate that the tools were manufactured locally. The absence of ceramic potsherds and polished stone tools would exclude their attribution to the beginning of the Neolithic. Other sites, such as those of Jamal Shah Sim, might be slightly older, because of the absence of trapezes and the abundance of abrupt retouched pieces, among which are points, bladelets, protogeometrics and triangular geometrics. Of particular importance is site at Jamal Shah Sim, which yielded a few curved, backed points, which strongly recall similar instruments from the Mulri Hills and Khadeji Gorge in Lower Sindh. At present the mobility patterns of the last hunter-gatherers can be established only on the basis of the circulation of the flint materials employed for the manufacture of the tools. Their estimated radius is much shorter than that proposed for the same populations of Rajastan (16) most probably because the investigated area is too small.



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Examples of notched microliths from Multi Hiils, near Karachi (afterr Rauf Khan**)***+,-%.-
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we take into consideration the sites of the Lower
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Sind. Although the typology of these assemblages

has not been studied in detail, the Mulri Hills flint industries seem to represent different periods of occupation, which most probably cover a long period of time, between the end of the Paleolithic and the beginning of settled life. The most diagnostic instruments are curved backed points, and geometric tools (different types of lunates, triangles and trapezes), denticulated bladelets and a few classes of cores. Their presence/absence or percentage varies site by site, suggesting that they are not all contemporaneous. Also the typological variability of the trapezoidal geometrics might be chronologically representative. It is important to point out that one site at Mulri Hill yielded a great number of these latter tools, while they are rarer at other sites, where the geometrics are represented mainly by different types of microlithic lunates.

The discovery of flint assemblages attributable to the end of the Paleolithic in Sindh fills a gap in our knowledge of the mesolithic in this part of Pakistan. Although there is no doubt that the Thar Desert sites of Upper Sindh can be closely linked with those of Rajastan, the assemblages of Lower Sindh represent a new and more problematic discovery.



The salt lakes of Lunar Sim (top) and Khat Sim (bottom) in Sindh around which mesiolithic settlements have been discovered (5)

The occurrence of Mesolithic settlements in Gujarat is of particular importance, because of their vicinity to the Karachi Gulf. The Mesolithic assemblages come from the surface and the uppermost deposits of the dunes, sometimes buried in 40–150 centimeters of sand. This suggests that Mesolithic man lived in Gujarat at a time when the dunes were in active formation. Other sites are known from quite different landscapes, along or close to river courses that flow into the Gulf of Cambay. Sometimes they are well stratified below Bronze Age layers, as in the case for Oriyo Timbo.

Mesolithic Sites in the Northern Parts of Pakistan: There are several Mesolithic sites in northern Pakistan, some of which have been properly studied and reported but most of them only casually

mentioned. The presence of microliths are proven in the Pothwar Plateau, although no truly Mesolithic site, in a cultural sense, has yet been reported from this area. A few sites in the Peshawar Valley in Mardan District, such as microlithic artifacts from Jamalgarhi cave close to the Sanghao Cave discovered by Dani in the mid sixties, have been mentioned. Microlithic artifacts have been reported from Marwat Kundi in the Bannu Plain on the surface of older alluvium. Further north from Sanghao cave, at Gichi Nala, near Chilas in Gilgit, Dani discovered a microlithic locality with quartz points, scrapers, triangles, large and small flakes and cores, which he placed between 5000-3000 B.C. Other sites in the northwest of Punjab are the Khanpur cave and Kot Kashmir-Takhtikhel area. There are some unconfirmed reports of rock shelters in the Salt Range with microlith industries also.

Elsewhere, in the northern Punjab, blade industries have been noted preceding the Mesolithic stratigraphically. These are closely comparable to the assemblages from southern Sindh and Las Bela. The presence of microlith industry in the North is, however, not as ubiquitous as it is in the South. It is believed that it wes due either to the lack of appropriate stone for making micro tools or to a lack of population density in the hilly areas where the climate during the preceding Upper Paleolithic was especially severe. The recolonization of the region probably took time and this is reflected in the late dates for the appearance of microliths in this area. Archaeological interest, therefore, shifts to the South and this is reflected in the following discussion.

Chronology: The detailed chronology of the Late Pleistocene and Early Holocene industries is difficult to assess because of the absence of datable organic materials; nevertheless a few observations can be made.

Efforts to date the South Asian Mesolithic period on the basis of microlithic technology were initiated by prehistorians who assumed that Europe was the point of origin of these industries; hence diffusion of full-fledged Mesolithic cultures to the tip of the Indian peninsula and Sri Lanka must have required several millennia of cultural diffusion through the interiors of Pakistan and India. Real or assumed technological parallels of Pakistan’s Mesolithic with the Mesolithic of Iran and other parts of western Asia, where microlith were assigned a greater antiquity, were sometimes also cited as evidence for the diffusion of microlithic technology from the West to the East and the chronology worked out in this context. This line of thinking found support in the relatively recent Holocene dates obtained from Mesolithic sites in India where antiquity of microlithic deposits was specifically investigated.

Didwana, Bagor and Budha Pushkar are amongst the most important Mesolithic sites of the Great Indian Desert in India. They all show similarities with those of Upper Sindh, especially for their geographic and geomorphologic location. The distribution of Mesolithic sites on the top of stabilized dunes seems to be linked with a moist phase during which the lakes were freshwater basins. If this view is correct, most of the flint assemblages of the Thar Desert recovered are to be referred to this climatic period, namely the early Holocene rather than the late Pleistocene.

The assemblages of Lower Sindh are more problematic; they still need to be studied in detail, in order to establish their chronotypological sequence. A radiocarbon date comes from a *Terebralia palustris* shell-midden discovered on the southern shoreline of the small bay of Daun along the Las Bela coast of Balochistan, a few kilometres south of the Gadani headland (70). This date (6380±40) can be related to the beginning of the exploitation of the mangrove swamp resources of the northern coast of the Arabian Sea. Just after 7000 years ago, when the sea level was a few meters higher and the environment of some coastal strips was significantly different from that of the present. It is during

this period that the first shell-middens began to be settled. It is surprising that the whole Makran coast of Balochistan, which has been recently surveyed intensively, did not yield any trace of either Mesolithic or shell-midden sites (17).

Bridget and Raymond Allchin (18) are among those who placed the microlith industry of the Indus valley and the surrounding hills in the early agricultural settlements of eastern Baluchistan and western Sind, ca. 8,000 years ago: “Throughout the Indus system virtually all microlithic industries so far recorded are associated with what appear to be permanent settlements. These include urban settlements of the Early Indus period as well as settlements of earlier periods with a less developed urban character which, on the basis of their size and relationship to later cultures, must be regarded as being within the mainstream of development of settled agriculture and urban life” (18).

On the other hand, the assays derived from early agricultural sites, such as the site of Mehrgarh, would suggest that “the beginning of the microlithic industries can be assigned to *ca.* 10,000 BC, that is, to the Early Holocene (4). This is in sharp contrast to a radiocarbon date falling in between 6,000 and 7,000 B.C. in Sindh, the Thar, Cholistan, Rajasthan, and the coastal region of Sindh. In either case, Pakistan seems to hold the record for the place of the earliest appearances of tools of microlithic manufacture; as mentioned above, Europe's Mesolithic tool assemblages appear much later in time.

None of the Pothwar sites is dated but judged from 14 dates from the neighboring regions, they could range between 4,000 to 6,000 BC. The upper layer of Sanghao Cave has been carbondated to *ca.* 3,000 B.C. but this occupation seems to be the result of a re-colonization of this region well into the Holocene epoch.The dates, wherever they have been attempted, for the appearance of microliths in India, fall much later in time – mostly around 3,000 years B.C. Sankalia, based upon artifacts from Rangpur, a Late Harappan site in Rajasthan, for example, takes note that microlith were found below the Harappan occupation levels and thus proposed the date of 3000 B.C. for this phase. This estimate is the same as that for the microlith from sites in Gujarat. This chronology is by no means certain. Even if these dates were credible, it only demonstrates a late development of Epipaleolithic cultures in India and a demonstrable lag between the Indus Valley and peninsular India.

The Mesolithic period in Europe coincides with the beginning of the Holocene epoch, around 8,000 BC and it lasted till 3,000 B.C. These dates coincide with the Mesolithic period in Baluchistan, such as at Mehrgarh in eastern Baluchistan. Here we observe a full-blown Neolithic settlement in 7,000 BC, and thus, technically, the end of the Mesolithic period.

A major problem in dating the South Asian Mesolithic is that many prehistorians have assumed that microlith tools are its hallmark, thereby overlooking the fact that microlith were manufactured from the upper Paleolithic to medieval times, indeed at some places as recently as two centuries ago. The socioeconomic life way of Mesolithic peoples may have been less dependent upon microlith typology than we had imagined. Nor does a high percentage of microlith in a prehistoric deposit mean that the manufacturers were practicing the same kinds of subsistence and settlement patterns which are supposed to be characteristic of all Mesolithic cultures.

The persistence of microlith into later prehistoric and historic times is hardly a mystery: microlith technology continued to thrive in pastoral and agricultural cultures along with other technological developments because these small tools have proven to be most efficient in the performance of certain activities.

Toward Managing Wild Foods: It has been stated earlier that during the Mesolithic, human populations in many areas began to exploit a much wider range of foodstuffs, a pattern of exploitation known as broad spectrum economy. This has been deduced from the archaeological finds from the Levant where most of the Epi-Paleolithic research has been conducted. These conclusions can be augmented by backward extrapolating the findings from the post-Mesolithic early human settlements in Baluchistan, primarily from Mehrgarh, on the border of Sindh and Baluchistan. The earliest section of this site represents a sedentary, nonceramic culture (before the invention of pottery). At this stage, these people were already agriculturists and pastoralists. By backward extrapolation of these findings one can visualize a state of affairs that may not be very much different from that of the Near East.

It is evident from the foregoing that during the late Pleistocene drastic changes in climate and earth morphology took place and along with it some fundamental changes in human subsistence also occurred; focus shifted from food gathering to food collecting and storing. Some hesitant steps towards food producing are also in evidence. At the same time, new food sources became available as changes in water temperatures led to increased marine resources such as fish and shellfish. These changes were first noticed in the Near East and West Asia and shortly after in the eastern end of the Iranian Plateau, that is, in Baluchistan and the coastal areas of Sindh. These pockets provide



The evidence for the utilization of sea food is rather limited, except oft a few isolated sites such as the above shell-midden of Daun, along the Las Bela coast of Baluchistan (5)

many examples of transitions in food-providing strategies, social organization, shelter, treatment of the dead, and artistic expression.

Some Mesolithic hunter-gatherers, such as the Natufian of the Near East, appear to have lived in small, although temporary settlements based on an economy involving gazelle hunting and the harvesting of wild cereals using sickles with flint blade segments inset in bone handles. In the Near East and North Africa, these populations processed wild plant foods using grinding stones. Most likely, the same situation prevailed on the hilly slopes of Baluchistan, which shared many aspects of the Near Eastern environment. It must be remembered that the life in the Mesolithic period was still generally one of movement from place to place on a seasonal basis in the time-honored way. Their communities were smallish, probably less than a hundred, though a given region might at times support a considerable number of their settlements and camp sites.

By 10,000 BC or at the most by a millennium later, man was experimenting with the domestication of

animals and plants. The domestication of animals led to pastoralism and the domestication of plants to agriculture. The development of pastoralism, in turn, led to semipermanent pastoral camps which the animal herders visited season after seasons. The development of agriculture necessitated the establishment of fixed settlements where men lived all the year round. Qualitatively, it was a tremendously important and highly significant turn in theeconomic and cultural history of man: it prepared him to approach ‘civilization’.

The seasons would have been marked by alternating dry and wet or cold and hot periods, inflicting considerable stress on humans and putting their subsistence in jeopardy. One way of dealing

with such environmental stresses, besides the adoption of semi-permanent residence in one place, was the deliberate management of plant and animal. Microscopic studies of the edges of Natufian sickles show that they were used to harvest wild cereals. The use of a sickle increases the yield of seeds from grain plants. Natufian people used large stone mortars to grind wild grains - the first evidence of cereal processing. In the Zagros moun- tains, in the northern Levant region, Mesolithic people began to manage animal populations through selective hunting practices. Selective killing of adult male gazelles indicates that people were deliberately removing nonreproductive members of the herd to ensure that herd size and survival would not be jeopardized. No archaeological evidence has been found in Baluchistan from this stage of cultural change but it could be safely assumed

that parallel changes must have been occurring in Baluchistan too.

The survey of the cultural and historical geography of Baluchistan, Sind, and northern Punjab reveals the natural variables that would have provided the subsistence economy of the region. It appears that with the warmer and somewhat moister conditions of the early Holocene, dense woodlands with heavy concentrations of nut bearing trees and shrubs emerged. On marginal lands, jujube (*ber*) shrubs appeared. These provided the Mesolithic and early Neolithic people with nutritious food which could be collected and stored. At Mehrgarh’s early stratum, grape pits were also discovered.

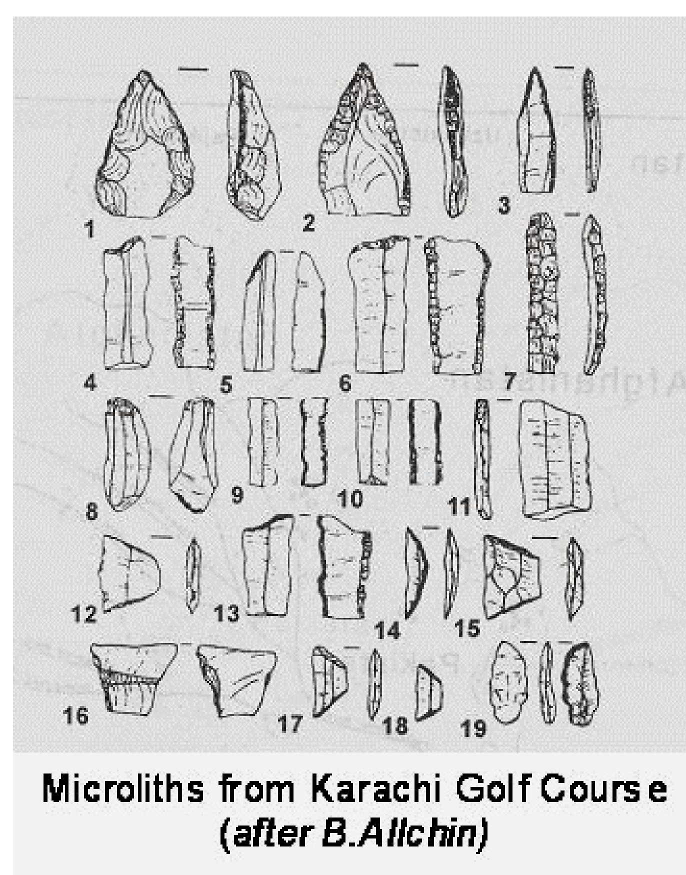
There was abundant game: wild sheep, goats, pigs and gazelle were plentiful in the foothills of Baluchistan, the foothils of the Sulaimans and Pothwar plateau. Wild cattle, including buffalos, must also be present, especially in the plains of the Indus. Places like Manchhar Lake and the lakes formed by several mountain streams and swollen rivers must be teeming with fish. Notwithstanding the lack of direct archaeological evidence, coastal areas must be exploiting the resources from the sea. Grain was available from several grasses, the most important of which was wild barley. Wild pistachios, prunes and almonds were present in the valleys of Baluchistan and probably elsewhere.

At Mehgarh, around 7000 years ago or perhaps somewhat earlier, a cultural mosaic seemed to exist: a foraging economy combined with some rudimentary agriculture. Among the earliest architecture, we find very small rooms, not connected with one another. It is surmised that these rooms were basically used as storage bins, placed in rows and without any lateral entrance. It appears that the entry to these rooms was through the roof. The storage of foodstuff for later consumption was by itself a giant step in the direction of settled life, which we now call the Neolithic. The bones of cattle, wild goats and sheep, buffalo, elephant, and other ani

mals are commonplace in archaeological sites im!

mediately following this timeframe, that is in very early Neolithic settlements, like Mehrgarh and Kili

changed ecological conditions associated with the retreat of glaciers, the disappearance of large game of the Ice Age, or a result of the advances in technology. Characteristics of the period were hunting and fishing camps along rivers and lakeshores.



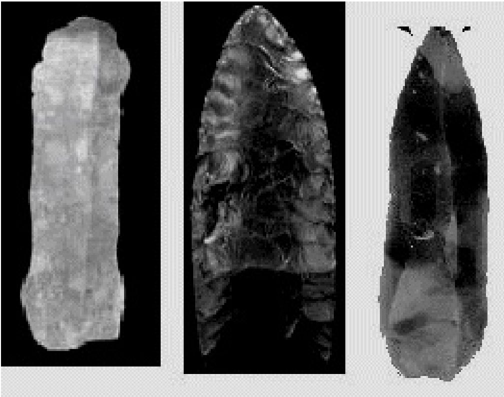
Microliths from Karachi Golf Course (*after B.Allchin*)

! Hunting and collection of botanical products continued to be the main supply of food but the humans

These sources provide us with tantalizing evidence about the life at the beginning of agriculture and animal domestication in Pakistan. This evidence is supplemented by the depiction of scenes of hunting, fishing, trapping of small animals and plant food collection in the contemporary rock paintings in Kirthar Range in the South and the Chilas valley in the north. Additionally, we must take advantage of the knowledge gathered in the Levant and extrapolate it to the Indus Valley, of course, keeping in view the specific environmental conditions of this area. Archaeological literature on the Near East provides several descriptions of this nature (19).

began to store food for later consumption. Taming or even domestication of some animals is the main development of this period. Microliths (small tools), the typical stone implements of the Mesolithic period, started to prevail and some composite tools started to be made and used. Polished tools also started to appear.

In some geographical areas, such as the coastal region around Karachi, the presence of Mesolithic period is research on the problem of plant and animal domestication in the Middle East, further refined the above mentioned characterization of Mesolithic culture and placed the most important locus of change not on the subsistence system, per se, but on the evolution of what he called the “primary village farming community”. In the context of ancient Pakistan, it has been shown that a culturally defined Mesolithic period has not been traced anywhere with any archaeological certainly. The beginning of the ‘primary village communities’ was the

abstract thinking, which is the underlying foundation
norm throughout Baluchistan at the
quite evident and it seemed to

of man's culture, we know very little.

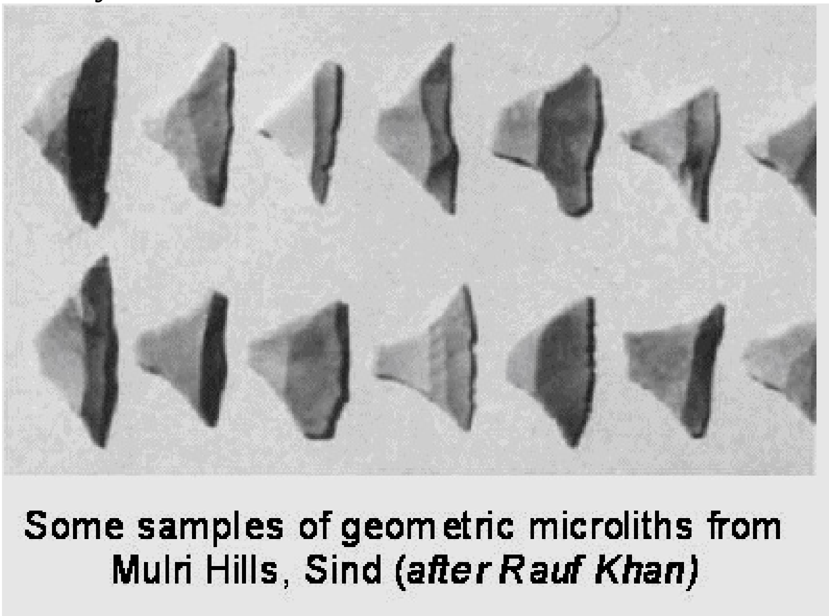
When did man beginning of the Holocene. If we consider last quite a long time. At some become aware of his own existence in relation to this era as the Braidwood's Mesolithic, we are at loss as to how we really define



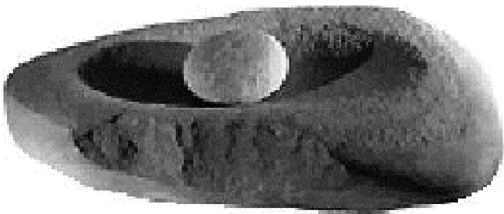
Although no direct evidence for the cultivation and haervesting of wild grasses is available anywhere in Sindh and Baluchistan, the presence hafted tools and grain processing implements indicate such a practice.

Abstract Thinking and the Arts: The Mesolithic Transition was a period of rapidly changing subsistence economy, technological improvement, and social organization. All of these factors touch upon the material side of man's existence. Of the nonmaterial factors, such as religion, arts and crafts, concept of the universe, in fact the entire

Wild fruit, such as Indian Jujube (the
the Neolithic. other sites, such as those in the
ber the universe or when did he begin to express him plains of Lasbela and Kachi, we **), amloke, pis**
The survey of the cultural and historical geography of Baluchistan and Sind self in abstract terms, are the questions that are **tachio, plums, cacti fruit, etc., and nuts, such as almond,**
reveals the natural variables that would have provided the subsistence economy
supplemented the diet of the foragers in Baluchistan and of the region. There was abundant game: important in human history. Where does the Indus


Some samples of geometric microliths from Mulri Hills, Sind (*after Rauf Khan*)

be rather short-lived. At most of the known population centers, however, no evidence of



Mesolithic period is at hand. It

wild sheep, goats. pigs and gazelle were man fit in this worldwide picture, is another question plentiful in the foothills of Baluchistan,
NWFP and Pothowar plateau. Wild cattle, that must be answered to bring the outline of his
The makers of the microliths in the plains of including buffalos, must also be present,

appears that in these regions, prehistoric cultural region in focus. Post-Pleistocene Sindh most probably lived in a landscape that was especially in the plains of the Indus. Places period, evidently, was playing a crucial role in shap covered by dry grass, with occasional Paleolithic period suddenly thorn like Manchhar Lake and the lakes formed

by several mountain streams and swollen rivers
learnt the domestication of animals and plants. The elementary settlements seem *acacia*
must be teeming with fish. ing the abstract as well as the material culture of Notwithstanding the lack of archaeological evidence, the coastal areas were food
bushes, alternating with open woodland, a certainwas available from several grasses, the most important of which was wild barley. this
land, as it was doing in other parts of the Old amount of relief in the form of rocky hills and fossil were present in the valleys of

World.
dunes.
Recent
research
Baluchistan. Besides this, we practically know nothing about the lifestyle of the
has discovered several There is plenty of evidence in some parts of There is plenty of evidence in some parts of advanced
provided with abundant seafood as well as the hunt. Vegetable
hunters-gatherers prior to the onset of agricultural revolution in Baluchistan and the world that man had already started to
think in Sind. Some information has been gathered from other primitive cultures and
5000 years B.C., which provides proof for the utili
extrapolated to the conditions of ancient Pakistan. For examples, Fairservis has
abstract terms in the Upper Paleolithic times. This is zation of water resources by the inhabitants of this on the archaeological evidencemore and more in evidence as man passed througharea in the Mesolithic stage of their development.collected in the Middle East and on the studies of the living hunting-gathering
bands in India, Africa, and Australia. the Mesolithic and entered the respective Neolithic 418

cultures. A manifestation of such abstraction is the origins of religion and the concept of life-after-death. We get a glimpse of it through the burial practices of the time. Another indication is the birth of visual art, which manifested itself through rock paintings and later on through the form and style of pottery or stoneware as well as the decorative paintings on pottery. Making animal or human figurines for decorative, symbolic, or religious purposes is another indication for such an abstract thinking or artistic impulses. Of course, other decorative arts, such as making of beads and ornaments, fashions in hairdo, and designs in textile also fall in this category. Only



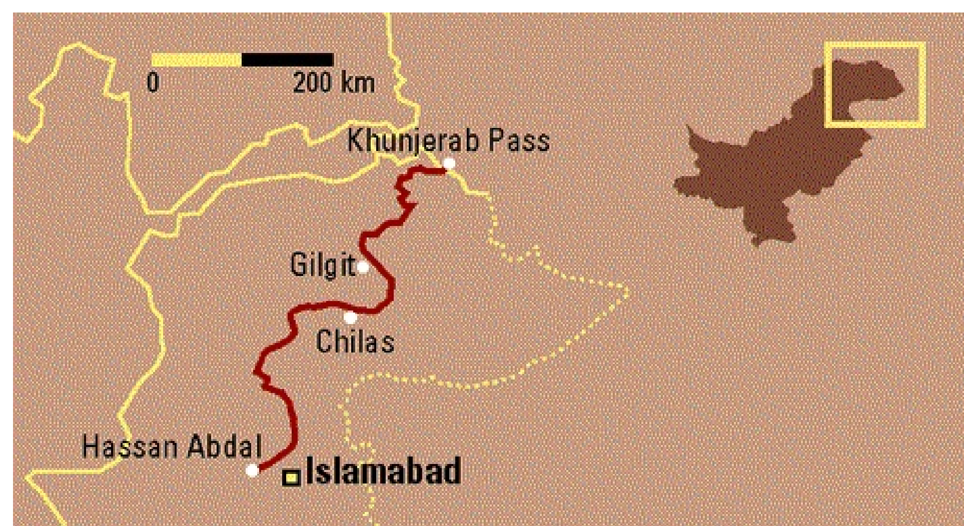
discuss simple problems, make plans, and pass on their accumulating lore to their children.

The occurrence of human and animal figures and different kinds of scenes painted or bruised on rock-surface has been known throughout Europe where most of the research has been conducted. Examples of rock art have also been found in Central Asia and Central India and these have been traced to their respective Mesolithic periods. A statue, a carved human head from an oblong pebble, has been discovered in Afghanistan, not far from Afghan-Pakistan borders. Within Pakistan, we find some rock paintings, some of them belonging

to the Mesolithic period, near the town of Chilas, in the shadow of the Himalayan peak, the Nanga Parbat, along the river Indus. But, all these belong to the very late Paleolithic times or, most likely to the Mesolithic times discussed in the following chapters.
Probably from the beginning of toolmaking early in Pleistocene times Paleolithic man communicated by sounds more explicit than those of the apes; perhaps by holophrases expressing total states or events. It has been pointed out that individuals in this condition are unable to use such undifferentiated blocks of experience for conceptual thought and are therefore unlikely to make inventions except by happy chance. The primary means of learning or communi

A view of the Chilas Valley in the north of Pakistan

rock painting have survived; other art and craft either did not exist yet or has perished for this period. Even the most dispassionate estimate of the Upper Paleolithic phase cannot fail to reveal it as the time when man first seemed to take a grip of himself and his surroundings and lay the necessary foundations on which, with such astonishing speed, civilization was to be built. It is most likely that a most important factor within this new awareness, this new sense of purpose, was that the latest Paleolithic hunters and gatherers had at last succeeded in bringing speech to a point where the precise naming of things and the elementary discussion of ideas had become possible. An alternative interpretation delays the moment of revolutionary progress until the Neolithic when a settled life and greater number of possessions provided an obvious incentive, while at the same time suggesting sharpened mental powers. This point of view has its adherents, but on balance the evidence would seem to support the opinion that it was during the last glaciation that men learnt to talk coherently together, to



An outline map of northern area opf Pakistan, showing the location of Chilas

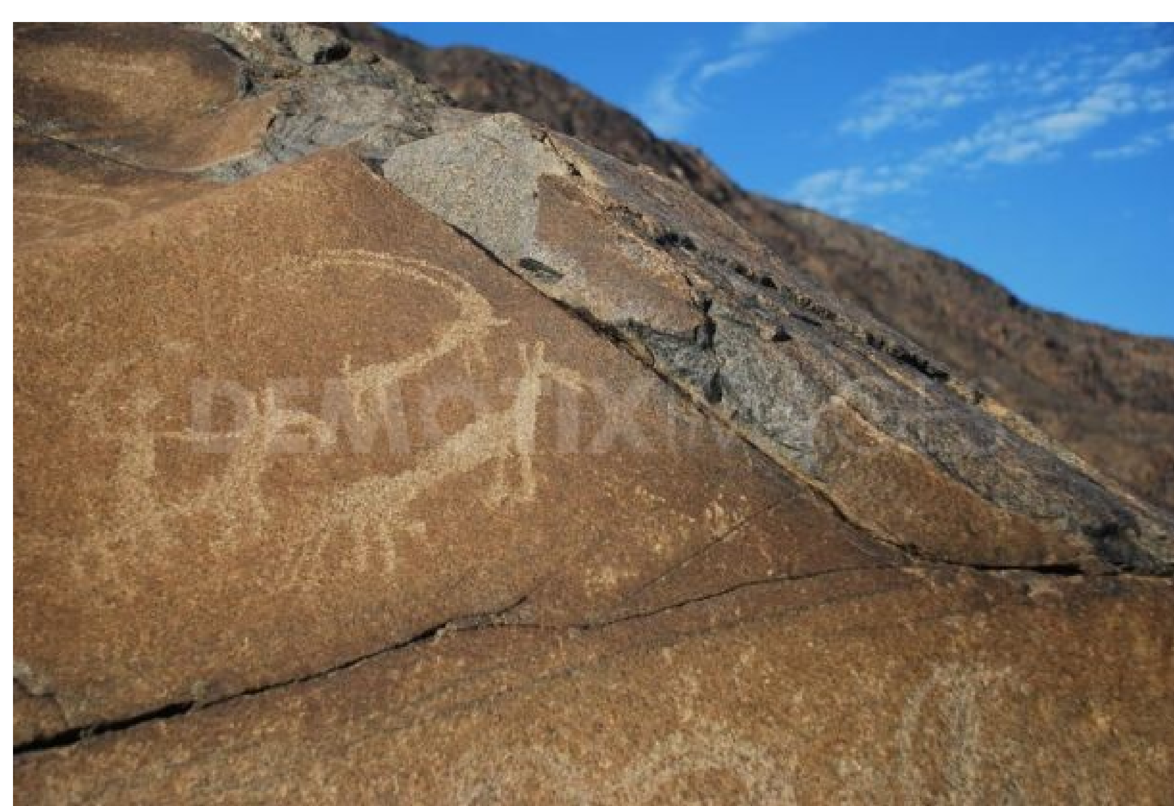
cating was the copying, just like apes. The change is, therefore slow if at all. In the Lower Paleolithic period the hand-axe, although it was gradually improved, remained in use as the dominant tool form for over half a million years. It has been agued that this almost unimaginable slowness of change demonstrates a lack of inventiveness that could only survive among societies without fully articulate speech. The Middle Paleolithic cultures achieved some more rapid changes if not very important advance; with the Upper Paleolithic there was a rapid acceleration, marked by a purposeful elaboration of specialized tools and weapons and the birth of a visual art in common of almost all the techniques practiced today.

This is not to deny that the great social changes of Neolithic times had a powerful effect upon language. Vocabularies must have been quickly enlarged, most of all by the words devised by potters, weavers and specialists of all kinds. Words for counting up to higher numbers would also have to be invented; it has been found that hunting and gathering peoples seldom have words for numbers above a very few. For example, even today the pastoral people with only marginal agricultural activities in southern Punjab, sometimes derogatory called the ‘Janglees’ (the people of the Jungle) cannot count more than twenty. If they need to say, for example, eighty, they would call the number as ‘four times twenty’.

There has been a long held impression of Western prehistorians that the Mesolithic was a Dark Age of hunting and fishing folks whose artistic efforts at painting stone pebbles and rock shelters failed to

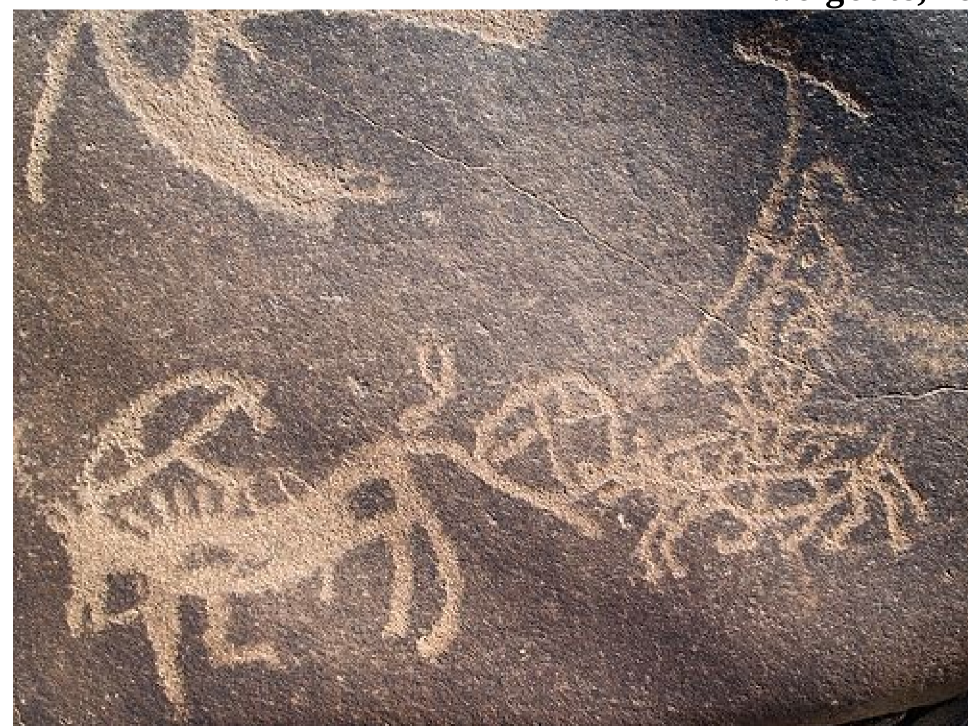
attain the aesthetics of Upper Paleolithic art of caves. This bias has rubbed off to the South Asian archaeology also. The facts are, however, different: based on the archaeological evidence from Sindh Kohistan and the Northern Areas in Pakistan and Bimbetka in central India, one must view this cultural period as a vibrant period of population expansion into new ecological niches, cultural innovations and abstract thinking. Recent studies in Pakistan demonstrate that the notion of a Paleolithic transformation into a Neolithic culture through a Dark Age of cultural stagnation is completely invalid, at least not for Pakistan and India, if not universally.

There is plenty of evidence in some parts of the world that man had already started to think in abstract terms as early as the Upper Paleolithic. As man passed through the Mesolithic Transition and entered the Neolithic, this faculty started to become increasingly evident in certain geographical areas, especially in South Asia, although the level of evidence from Europe and the Near East diminished. A manifestation of such abstract thinking is the origins of religion and the concept of life-after-death. We get a glimpse of it through the burial practices of the time. Another indication is the birth of visual art, which manifested itself through rock paintings and later on through the form and style of pottery or stoneware as well as the decorative painting on pottery. Making of animal or human figurines for decorative, symbolic, or religious purposes is another indication for such an abstract thinking or artistic impulse. Of course, other decorative arts, such as making of beads and ornaments, fashions in hair-do, and designs in textiles also fall in this category. In Pakistan, only rock paintings have survived; other art and craft either did not exist yet or has perished.



Hunters of markhors and wild goats, a rock painting from Chilas

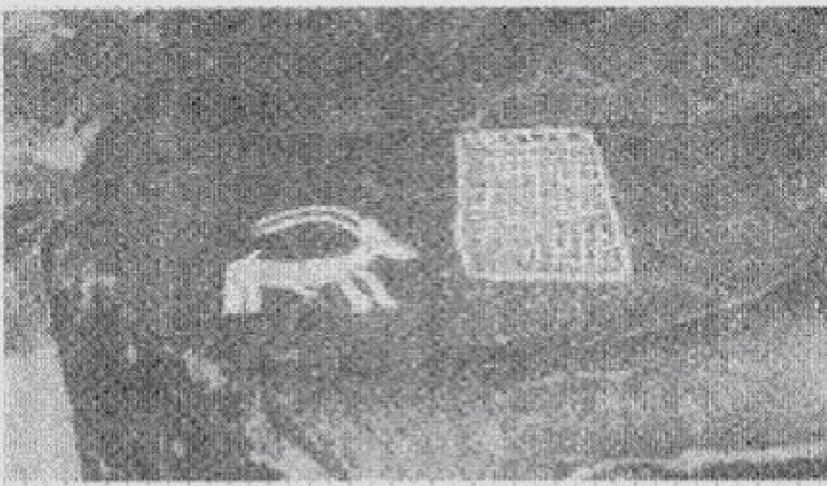

Two goats, rock drawing in Chilas


A donkey, a man, and a few other doodles

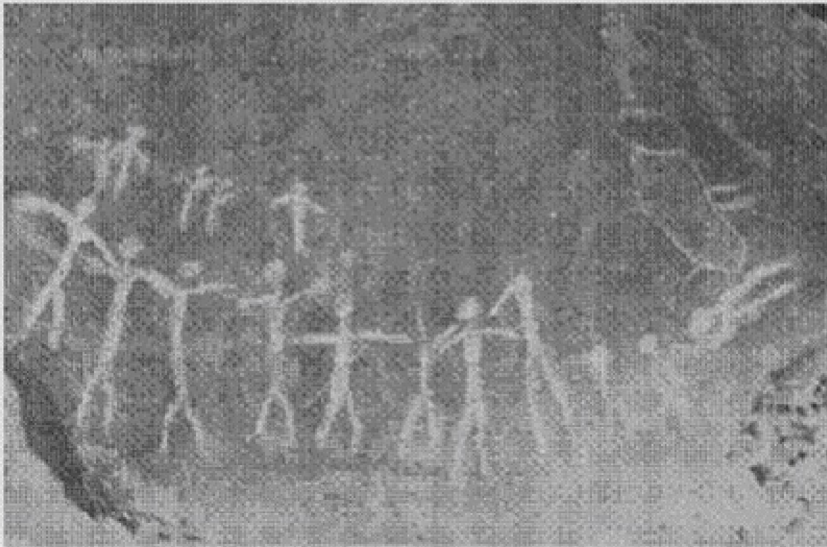
The occurrence of human and animal figures and different kinds of scenes painted or bruised on rock-surface has been known throughout Europe where most of the research has been conducted. Similarly, quite a few human burials have been discovered which may indicate some abstract



A snake biting a man - Chilas



An animal trap, probably a hole in the ground, covered



Men dancing, rock painting , Chilas (after Yahya Amjad)

Men (and/or women) dancing

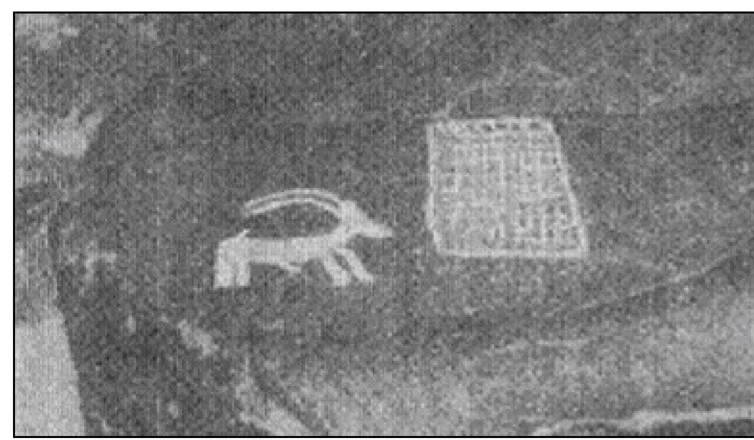


A miscellaneous rock painting in Chilas - a bull, a foot, and probably a running animal



An assortment of wild life at Chilas

Hunting of markhor with dog - Chilas


An animal and a trap, probably a covered hole - Chilas.

thought behind the practice. In Pakistan, and that goes for India and Afghanistan as well, no burials have been found that can be confidently traced to the time period under discussion. However, the examples of rock art have been recorded in the rock shelters of the Kirthar Range. There are also hundreds of rock paintings reported from Chilas in the northern region of Pakistan. Both of these findings are without any firm dates. They basically fall in the same category as those reported from central India.

The main basis of their dating in India is the occurrence of mesolithic material and pieces of red ochre in the rock-shelters of Bhumbertka. This, however, does not tell us much because the time span for the occurrence of 'Mesolithic material' in India is extraordinarily long starting from *ca.* 3000 years to the beginning of the Iron Age *ca.* 500 B.C. In Pakistan we are also at loss in determining the age of the rock engravings any better than that at gravings are found, as well. The area around Chilas has been particularly explored for rock paintings and engravings. The prehistoric carvings are seen there at Thakot plain, Thalpan Ziarat, Hodar, Thor North, Kinodas, Pustshop, Thakgah, and Minargah. In Skardu such carvings have been found at Shangrila, in Gupi valley at Matulasht, Rahimabad Das, Thujal, Payakush, and at the mouth of Yasin river.

Notwithstanding the absence of independent dating, the rock art in the North of Pakistan, especially around Chilas, in the shadow of the Himalayan peak of the Nanga Parbat, is often offered as an evidence of the occurrence of abstract thinking in the Mesolithic period in Pakistan. If we take the Mesolithic period of Pakistan as represented in the South, that is, a chronological time period spanning 15,000 to ca. 6,000 B.C., then the rock paintings at Chilas definitely are *not* Mesolithic. However, if we ignore the chronology of the Mesolithic elsewhere in



One of the recently discovered rock paintings in Kirthat Range, Sind. These paintings are ascribed to the Mesolithic of Baluchistan. The painting describes a hunting scene, probably a wild goat or wild cattle. Note the similarities between human figures of this drawing and those of Azarbeijan and Chilas.

One of the recently discovered rock paintings in Sind Kohistan. These paintings are ascribed to the Mesolithic of Baluchistan but may be of later period. The painting describes a hunting scene, probably a wild goat hunt

Pakistan and concentrate on the local context, where the Mesolithic culture, and then the Neolithic, arrived rather late, 4,000 B.C., on quite late, probably *ca.* 1,000 B.C., then the Chilas rock paintings do fall in the category of the Mesolithic art, in parallel with that of Central India where the Mesolithic covered a time period even to more recent dates than that of Chilas, roughly between 3,000 B.C. and 1000 B.C. Just like the rock paintings in Central India, the rock-art tradition in Chilas continues well

into the historic period. It is important, therefore, to separate the probably *ca.* and lingered

obviously from the ones, which is often not easy. Dani identified 20 paintings belonging to the Mesolithic period at Chilas;

about 150 paintings are of later times.

The Northern Area of Pakistan is located at the junction of three great Paleolithic regions: South Western Asia, South Asia, and Sibeia-Mangolia: all three have their own sequences and their Mesolithic/Epi-Paleolithics significantly differ from the Paleolithics of the rest of the country. The rock art from this area should, therefore, be understood in its geographic context by placing it in wider perspective of rock art as known from the surrounding areas in the Transpamir side, Xingjiang (China), Ladakh, Kashmir, and Swat. In prehistoric times, access to the mountain valleys between the later paintings

genuinely early

Bhimbetka in central India. Here also the presence of microliths is taken as the basis for placing these engravings in the Mesolithic transition.

The pre-historic engravings in the Northern Areas of Pakistan were first noticed by Durand and Bidullph and then by Karl Jetmar (20,21,22) and A.H.Dani (23) who attempted to put them in their prehistorical context. The engravings are largely concentrated along the Karakorum Highway from Shatial to Chilas on either side of the Indus River, then at the confluence of Gilgit and Indus River and Nagar and Hunza River. In Gupis and Yasin valley also several sites having prehistoric engravings were discovered. In Skardu similar prehistoric enKarakorum in the north and the western most Himalayas was easier from this side. The study of the material contents of life, as depicted in many of these paintings, is an important source of information about the prehistoric life in the north of Pakistan. Systematization of our knowledge about Chilas rock-art has only begun, and no useful purpose will be served here by trying to take the whole range of related issues into consideration. Our concern in this section is only to highlight some of these paintings as it manifested itself in the area around Chilas.

All of the early paintings, with which we are concerned here, have been engraved on rocks rather superficially and most of them are not clear. They basically consist of line drawings. Nevertheless, we see two main subjects in these paintings: men and animals, mostly men and animals together. These pictures are realistic rather than abstract presentation although elements of abstraction are not entirely absent. Among these rock paintings, animals have been depicted more realistically and dynamically than men, who have been depicted largely as a static outline. Two things are common: first, the same techniques have been used to draw, second, all of them are objective representation of animals and hunt. No painting shows any sign that could be taken as a representation of agriculture. Neither there is any indication in these paintings that could shed some light on the residential pattern of inhabitants.

The depiction of sheep, wild goat, and *markhore* is common, although in some, yaks have also been represented. Several paintings show dog, sometimes simply walking with a human figure and sometimes alone. Some archaeologists have concluded from these figures that the dog was already domesticated. Similarly, the way sheep has been depicted in these paintings gives rise to speculation that the Mesolithic

peoples in the Chilas region had
already domesticated sheep or at least kept it as pets. In one picture, for example, a sheep is following a walking man and a child. Birds, especially *chakore*, have also been depicted. In one painting, a *chakore* is shown feeding its chicks. Another painting interestingly shows a humped bull. Since cattle could not exist in these high mountains, the depiction of a humped bull clearly shows the communication of these people with those living in the plains of Punjab where cattle was abundant.

The figures of both men and women show a tail between the legs. This depiction has been taken as an indication that the people used goat hide as a loincloth. There is, however, no indication of any cover over the breasts. Some male figures have been depicted completely naked. A painting depicts a wild goat in front of which one observes a netlike structure. This drawing has been taken as an evidence of the practice of animal trapping. Some rock paintings depict hand and foot imprints deeply engraved in the body of the rock. Surprisingly, the picture of only right hand has been engraved. While the depiction of hand is detailed, with fingers and thumb shown clearly, foot has been shown only in outline. Here too, it is always the right foot.

Men and women are shown in outlines, mostly engaged in a hunt. Bow and arrow has been depicted in several drawing in context with hunting scenes. In other hunting scenes, men are trying to kill a goat by throwing stones. Snake is frequently drawn, mostly as a curvy line. In one drawing, two snakes are attacking a man while another man seems to be running to his help. In another picture,


Rockart from pre-Neolithic northern Iran

two snakes are attacking a woman who has two children, one on her right shoulder and one on the left, as though she is trying to protect them from the snakebite.

In one painting, seven men are carrying a long ladder-like structure, which seems to be a rafter for crossing river streams. Such rafters are still used in that area as boats. In another picture a 'superman' has been depicted. The figure has a loincloth, his legs are spread laterally, and his toes are pointing in opposite directions. It appears that the legs have been tied up with a rope. This may as well represent the victory over a *bhoot* or *dev*, namely, an evil spirit. If it is in fact the case, we are looking at a clear

manifestation of a shamanic religion which is supposed to be a popular creed throughout the Indus Civilization in later years. In another picture, a hunter is wearing a hat with horns. This is again correlated with the paintings of a 'horned deity' on pottery of the Early Indus period. In one of the drawing, a man is carrying a stag head mounted on a long stick in a group-hunting scene. This could as well be thought of as a totem pole or a shamanic ritual. Taken these symbolic depictions together, one cannot escape the conclusion that some sort of religion was already in place which resembled shamanism of the Indus Civilization several millennia later.

In one drawing, several men (or women) are standing in a circle, holding each other's hands. This may be a representation of a group dance. A few drawings depict group hunting wherein dogs are ever present. In one picture, a man, and a woman are standing enclosed within a fence. In another picture, a woman is standing in a triangle of which one side is open. A man is entering the triangle from this open side. In still another drawing, a man and woman are standing or lying close to each other. These pictures probably signify the concept of family.

Some interesting rock paintings have recently been discovered in the Kirthar Range, Sind. Most of these drawings are thought to belong to the Mesolithic period of the region. Hunting scenes depict the use of bow and arrow, along with spears and clubs. The animals depicted are small game, probably deer, wild goat, or wild cattle. The depiction of humans is interesting. All of these drawings resemble those found in northern Iran and Azarbeijan and come close to those depicted in rock paintings at Chilas in northern Pakistan.

Mesolithic Transition in the Borderlands: Western Asia presents a general uniformity of hunting-gathering cultural assemblages of later days which vary but little. Two of these assemblages, the Natufian of Palestine and the Karim Shahirian of north-eastern Iraq, contain grinding stones, polished stone celts, and sickle blades. There is evidence that these peoples ate wild goat, sheep, and cattle, as well as used the seeds of wild grasses in their diet - a not surprising piece of evidence in view of the fact that representatives of this fauna and flora were abundant in the region of settlement. It should be noted that the same type of flora and fauna existed in abundance in parts of Baluchistan, eastern Afghanistan and southern Turkmenia. However, since not enough archaeological work has been done in these areas, it is difficult to compare the Mesolithic developments here with those in the Near East.

The Mesolithic developments in Afghanistan and the rest of the Central Asia most likely paralleled to those in northern Baluchistan but we do not have any concrete archaeological evidence for it. The microliths found at Aq Kupruk and a few other sites are generally of later times, a time period when the entire Baluchistan was in the throws of the Neolithic development. On the other hand, the microlithic tools, a hallmark of the Mesolithic period, have been found on the sand dunes south of the Amu Darya dating 10,000 B.C. where some early signs of domesticated animals have also been noticed. Taking all of this information together, it is reasonable to conclude that the Mesolithic developments or the transition from the Paleolithic hunting-gathering cultures to the Neolithic agricultural lifestyle probably happened here contemporaneously with those in Baluchistan.

Like the region to its west, Pakistan is a land of considerable geographic diversity. The whole region, but particularly the uplands of Baluchistan and the foothills of Sind Kohistan, is the seat of a broad spectrum of plants and animals which included forms which were in time to be domesticates of man. From Baluchistan to Afghanistan and Turkmenistan across the Iranian plateau and the ranges of the Antilles and the Zagros could be found, in wild form and in different quantity, goats, sheep, cattle,

pigs, barleys, wheat, and other us- able but apparently not yet domesticated species of plants and animals. These temperate zones were narrow and were situated next to the relatively marginal or truly arid regions. In times of greater or lesser rainfall the material areas expanded and contracted. The marginal areas were thereby always in a state of flux, while the essential desert and upland environments remained the same. Since the same type of ecological factors were at work in the dry zone of Pakistan, it is logical to assume that the cultural adaptation could be similar in all these regions.This is indeed indicated by the general similarities in stone artifacts. The use of the bow and arrow is depicted in rock drawings throughout Central Asia and Pakistan, including such diverse geography as the Kirthar Range in the south and Chilas mountains in the extreme north. Almost all cave drawings depict hunting scene where the game is small animals, such as deer, wild goat, and cattle. Furthermore, just like the marginal areas of the Thar in Sind, the borderlands of the Central Asian deserts show a rapid increase in population at the onset of Holocene. Beyond these, nothing definite can be said because enough archaeological data is not available. While these data show the contemporary nature of Central Asia with those of Baluchistan and Sind, some data suggest otherwise. For instance, the comparison of rock paintings show no clear theme: while one notices the common styles between the drawings from Azarbeijan and those from Kirthar Range, Sindh, no such commonality is noticed in case of Uzbekistan.

Among archaeologists of India at the present time “Mesolithic” is commonly used in a wide and rather loose sense to cover hunters living in the hills and forests of Central India and elsewhere, fishing communities all around the coast, and nomadic herdsmen of many regions. It is generally believed that many such communities must have been in contact with the urban centers of the Indus Valley from the third millennium BC and with settled communities of various kinds from a much earlier date. However, it is hard to imagine how. Geographic features of the region dictate that such a possibility could exist only in the south, where Gujarat and southern Sindh met. In the absence of any meaningful contact, therefore, the developments in the eastern borderlands at the end of the Ice Age markedly differed from those occurring in Pakistan and Central Asian regions. These differences, as seen earlier, put the two regions, one comprising Pakistan and Central Asia and the other comprising the Indian landmass, on two entirely different development trajectories. Whereas the West rapidly marched to a lifestyle of settled agriculture and then to that of urban cities, the inhabitants of the East continued to live in pastoral camps for thousands of years to come. This outcome should not be surprising. The respective Middle and Upper Paleolithic cultures of the two regions had already laid its foundation several millennia ago. The overwhelming contribution to this disparity and differentiation was, obviously, due to the geography and the environment, discussed in some detail elsewhere.

Place of Pakistan’s Mesolithic in the the Old World: Pakistan holds the record for the earliest appearance of tools of microlithic manufacture. These tools are found all over the country, starting from as early as 20,000 years ago and lasting at some nooks and corners to perhaps as recently as the onset of the Iron Age. The Mesolthic stage in Pakistan is distinguished by vivacious technological and artistic advances, as represented by cave paintings, early experimentations with plant and animal domestication, and adaptations to a broad spectrum of habitats in different eco-niches.

The microliths of Pakistan are technotypologically similar to their counterparts in the Near East, North Africa and Europe. There are crescents, lunates, trapezoids and a wide variety of triangular forms, and beautiful polyhedral cores. In this respect, the Mesolithic of Pakistan is closely related the world to its West and bears witness to the general course of technological development of humans in

their quest for assuring them a reliable supply of food. Thus, anything found here is pertinent to the prehistory of man. Among these contributions is the augmentation of the archaeological evidence that there was cultural continuity between the Paleolithic and Neolithic traditions. This is in contrast to the situation in Europe where a hiatus separated the end of the European prehistoric cultures of magnificent cave paintings and sculptures from the time of emergence of agriculture and pastoralism. Pakistan now holds the record for the place of one of the earliest appearances of microliths; Europe's mesolithic tool assemblages appear much later in time. If further archaeological worked done, these early developments in microlith tool technology could make it possible to trace this cultural transition from the Upper Paleolithic to the Neolithic, thereby handsomely contributing to the evolutionary history of man in general.

While the Mesolithic tools, primarily the microliths, follow the pattern of the West and clearly lead the way to the development of agriculture and settled life, the situation in the neighboring India is quite different. Here the microliths appear rather late in time and persist for a long time without leading to the Neolithic. In other words, while the microliths in Pakistan are an integral part of a Mesolithic culture phase, in India they do no bear such a relationship with mesolithic as the term is understood in Europe and the Near East. In this sense, while we see some similarities in the course of mesolithic cultural change between Gujarat and southern Sidh, we do not see a parallelism on a broader scale.

Summary: The Mesolithic stage of cultural development is generally understood to be



characterized by the introduction of new tool technology the microliths and composite tools - and by some probable movement to the domestication of animals and plants. In Pakistan, the Mesolithic is not a discrete cultural phase but rather a transitional period that connects the Upper Paleolithic to the Neolithic.

The evidence from Baluchistan indicates a movement towards permanent settlement and the domestication of goats and sheep. The beads of shell and out-of-region colored stones at Mehgarh points to some long-distance contacts with other human communities and possibly to a rudimentary system of exchange. The evidence for the existence of residential structures has not been found but for the food-processing artifacts such as querns and mulIers is clear. It indicates the beginning of a quasi-sedentary or semi-settled life. Though it is not possible at the present stage to define how settled was their life, it may be surmised that wherever food and water was available all the year round, the

Mesolithic people were living there permanently. The indications from northern Baluchistan are that the inhabitants were already on the threshold of the Neolithic phase - a phase dominated by the beginning of farming activities, cattle herding and settled life. On the other hand, the Mesolithic man was still living in Paleolithic times, making the same type of tools and existing on the same types of activities related to self-sustenance and subsistence. This period should, therefore, be looked upon as a continuum from the Paleolithic to the Neolithic. There is no concrete archaeological evidence to support this description of the Mesolithic but it should not be far from actuality: the evidence from other, better researched, areas coupled with some relevant evidence from Mehrgarh point us in this direction.

In Pakistan, the presence of microliths iare ubiquitous in Sindh and the coastal strip of Las Bela, and they seem to last to the beginning of agriculture and animals domestication. At some of the known early population centers, such as the area around Rohri Hills in Sindh, microliths are present at a very early stage, probably during the Upper Paleolithic, but no agriculture developed there in subsequent times till late in human prehistory. In other regions, such as in the Kachi plain (eastern Baluchistan), the hunters-gatherers of Paleolithic period quickly learnt the domestication of animals and plants and entered into the Neolithic culture without going through a clear and discrete Mesolithic interval. Obviously, in these regions the transition period must have been very short or, according to some archaeologists, almost non-existent. The same pattern seems to be prevalent in Afghanistan where a few Mesolithic sites have been discovered which are chronologically comparable with those of Baluchistan for their transition to the Neolithic. Peninsular India, on the other hand, seems to fall in the other category. Here the microliths are noticed quite early on but not signs of subsequent development of agriculture till quite late in time.

The Late Pleistocene period of South Asia is rich in rock art. For example, Northern Areas of Pakistan and Bhimbhekta caves in central India have the richest prehistoric rock galleries in the world; some of these rock engravings seem to belong to this period. They throw valuable light not only on the aesthetic sense and artistic taste of the Mesolithic people but also enable us to reconstruct their socio-economic behavior. Archaeological evidence at present is not sufficient to give a complete account of the pre-historic culture of man in this region but enough is now known as to whet our appetite to know more.

The Mesolithic sets the stage for the entry of man into the exciting period of human history wherein humans forsakes their primitive ways of subsisting on foods that nature chooses to give to them and opt to adopt a way of life wherein they produce their own food and live in permanent settlements. At the end of the day, man arrives at the doorsteps of civilization - one at the western end of the Iranian Plateau, that is, the Mesopotamian Civilization, and one at the eastern end, that is, the Harappan or the Indus Civilization.

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VII.4. References

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SECTION VIII





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!!! VIII.1. Understanding Foragers
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VIII.2. Paleolithic Diet through the Ages
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VIII.3. Focus on Subsistence Economy
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VIII.4. Desert People
VIII.4. Desert People
VIII.5. References
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VIII.0. The World of Hunter-Gatherers

This section explores the world of hunter-gathers, particularly their changing subsistence regime and social organization. Throughout the Stone Age, humans depended on nature for their subsistence. They obtained their food through hunting; scavenging of carcasses killed by other predators; trapping of small animals and birds; gathering aquatic food such as trapped fish in shallow waters, mollusks and shellfish; picking berries and wild fruit; collecting nuts; gathering grass seeds; and foraging on easily digestible tubers and plant leaves. The Stone Age people were basically a foraging societies, constituting of small population groups who moved around a lot in search of food. By early Holocene they were rapidly replaced by agricultural societies or pastoral groups. The transition was, however, not complete: by the middle of the second millennium AD, foragers still occupied a third of the globe including all of Australia and most of North America, and large tracts of South America, Africa, North, and North-East Asia. Yet in recent centuries foragers have retreated precipitously in the face of the steamroller of modernity, occupying only those areas where farmers simply cannot go, or where farming is so marginal as to be uneconomic.

The existence of these ‘relic’ societies in modern times gave incentive to anthropologists for their study with the aim, among others, that such investigations might shed useful light on the social organization and subsistence economy of the Paleolithic peoples. Although foragers today are part of the same global society as the rest of us, and in no sense can be regarded as living embodiments of any kind of prehistoric lifestyle (1), the behavior of present-day foragers remain an invaluable resource for helping us reflect on the likely characteristics of forager behavior before farming.

In this section we shall attempt to reconstruct the Stone Age society, taking our direction from a number of ethnographic studies that have been conducted in recent years. We shall augment these conclusions by archaeological data from West Asia where more research has been done than South Asia. Our focus would be on the subsistence economy because it is the one that differentiates the Paleolithic (the Stone Age) from the Neolithic (the food production).

Our preference for using anthropological categories such as hunters, gathers, foragers, pastoralists and farmers for the prehistoric people can be traced back to mid-eighteenth century Europe, when social evolution or ‘progress’ was first widely expressed and systematized as universal histories. In this context, a hunter-gatherer society is one whose primary subsistence method involves the direct procurement of edible plants and animals from the wild, foraging and hunting without significant recourse to the domestication of either.

VIII.1. Understanding Foragers



For most of the human history, human groups have made their living through foraging on natural resources. This included hunting of wild animals; scavenging of carcasses of animals killed by other predators; collecting of marine resources, such as mollusks, shellfish, and occasionally

trapped fish in shallow waters; gathering of wild fruit, nuts, and edible plants, and perhaps trapping of small animals and birds. It is therefore not surprising that the study of human foragers, especially hunters and gatherers, has become an increasingly popular and central topic of research among anthropologists, archaeologists and nutritionists. At the same time it has provided a meeting ground for a range of disciplines, all concerned in one way or (2). In addition to this primary characteristic of 'not being farmers', there are or have been two other very common features amongst recent and contemporary forager societies: (i) they live in small groups, and (ii) they move around a lot. However, the demarcation between hunter-gatherers and other societies which rely more upon plant and animal domestication is not clear-cut, as many contemporary hunter-gatherer societies combine both strategies to sustain themselves. At the end of the Pleistocene, forager societies peopled most regions of the world. By the middle of the second millennium AD, foragers still occupied a third of the globe including all of Australia and most of North America, and large tracts of South America, Africa, North, and North-East Asia. Yet in recent centuries foragers have 'retreated precipitously in the face of the steamroller of modernity' (1), occupying only those areas where farmers simply cannot go, or where farming is so marginal as to be uneconomic.

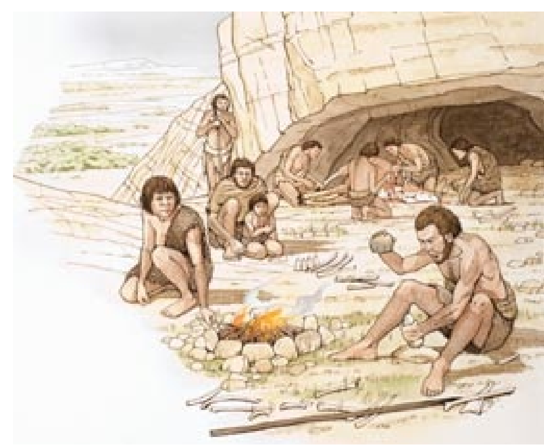
another with aspects of human behavior that sustained human life in the wild during the millennia before the advent of agricul ture and animal herding. Archaeology has provided the needed data towards this goal. However, analysis of the prehistoric record has inevitably lagged behind the development of fresh theoretical perspec tives. The study of modern hunter gatherers tries to bridge this gap by com bining the discussion of recent develop ments in ecological and social theory with the analysis of prehistoric data from many of the classic areas of paleolithic studies in Europe, Africa and, increasingly, Asia.

Hunter-gatherer or forager socie ties, as the names imply, have been de

fined first and foremost by their mode of
subsistence: 'hunting of wild animals,
gathering of wild plants, and fishing, with
no domestication of plants, and no domes



ticated animals except probably the dog'
(1). Another recent survey develops this
defining characteristic in the following terms:
'*the absence of direct human control* over the re
production of exploited species, and little or no con
trol over other aspects of population ecology such
as the behavior and distribution of food resources.
In essence, hunter-gatherers exercise no deliberate
alteration of the gene pool of exploited resources'
Hunters and gathers have always been important in social and cultural anthropology as well as in archaeology. Many of the great figures in these disciplines and even founders of the social sequences more broadly, developed their ideas about the prehistoric human condition through the examination of hunters and gatherer in their contemporary worlds. Images of a hunter-gatherer lifestyle as humankind’s natural existence, as the earliest stage of social evolution, or as the antithesis of modernity, have had a profound impact on the development of countless theoretical ideas on society and culture, which, in turn, have strongly impacted the visualization of prehistory. These images have changed through history and have consequently modified the conceptualization of the lifestyle of humankind in writing its prehistory and the processes of its cultural development. The ninth International Conference on Hunting and Gathering Societies was held in 2003 at Edinburgh with the explicit purpose of examining the history of these perceptional changes; the contributions were later published by Alan Barnard (editor) under the title *Hunter-Gatherers in History, Archaeology and Anthropology.* This collection of papers amply illustrates the diversity of views and the changing ideas on hunter-gatherers through time.



It is extremely difficult to translate foragers' behavior as recorded today or in the recent past into theories of general applicability to the world's prehistoric foraging population prior to farming. The task is all the more complicated by the remoteness of the everyday lives of foragers (present and past) from the present researchers. Nevertheless, these surrogate studies are important because they at least furnish us with a starting point of speculation on the lifeways of the prehistoric people prior to the advent of agriculture and sedentary living. There is today, and has been in the recent past, considerable variability in forager societies; much more striking are the similarities that can be discerned in the economic, organizational, and ideational or cognitive solutions that most of them have developed for living as they do. For all the difficulties of using ethnographic material, the behaviors of recent and present-day foragers remain an invaluable resource for helping us reflect on the likely characteristics of forager behaviors before farming (3).

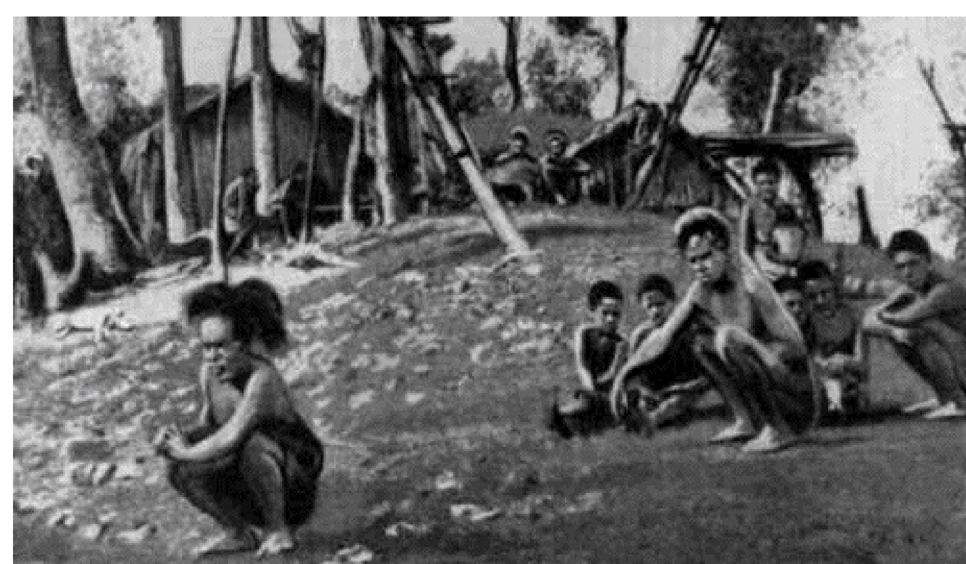
Historical Developments in the Studies of the Hunter-gatherers: The basic concepts of modern anthropology, including ideas on culture change and social evolution, were developed in the sixteenth and seventeenth centuries. However, early concerns with peoples we would now call ‘hunter-gatherers’ was largely hypothetical. The seventeenth-century writers tended to be interested not with ethnographically attested peoples but rather with an imagined state of nature (5). It was only in the eighteenth century that subsistence and its relation to society became truly meaningful topics of intellectual discussion. The most recent phase of hunter-gatherers studies dates from the 1960s and can be linked with broader currents at neoromanticism and environmentalism (6). Today, property has returned as a central focus in huntergatherers studies. This, again, is mostly motivated by the prevalent sentiments for the ‘natural order’ of capitalism. In recent years hunter-gathers have also become the center of attention by nutritionists which are apparently in search of the perfect ‘paleolithic diet’.

The most recent focus seems to be on changes in social structure in developing societies, acculturation, ethnic pluralism and emerging class relations. While these theoretical foundations were being molded, ethnographic studies throughput the world served both to bolster theoretical speculations and to build up pictures of regionally specific forms of hunter-gatherers society; studies on the San people in Africa and the aborigines in Australia are noteworthy. A large number of studies have been done on Indian ‘tribals’ but they are generally descriptive and none is noteworthy for prehistorical or theoretical interest. No hunter-gatherers group of people has been recognized in any part of Pakistan in the recent past and thus no such ethnographic study is at hand. Thus, by necessity, our conceptualization on the nature of hunter-gatherers societies and the process of its change to Neolithic settlements derives from studies done in other regions, most appropriately in comparative ecosystems such as the margins of Kalahari Desert rather than the tropical forests of India.

In a paper presented at 1990 Conference on Hunting and Gathering Societies , Richard Lee mentioned in passing six key issues in huntergatherers studies since the 1960s: evolutionism, optimal foraging strategies, woman the gartherer and man the hunter, world-view and symbolic analysis, hunter-gatherers in prehistory, and huntergatherers in history. In 2003 Alan Barnard (5) added two more to this list: relations with outsiders and indigenous voices. In this section, we are more concerned with the presumed nature of huntergatherers in prehistory and the process dynamics of their acculturation with agricultural norms at the end of the Paleolithic stage.

Surviving Hunter-Gatherers: Although few hunter-gatherers or foragers exist today, they are well documented in the ethnographic record. Anthropologists have been eager to study them since they assumed that foragers represented a lifestyle that existed everywhere before 10,000 years ago and characterized our ancestors into some illdefined but remote past. In the past few decades, that assumption has been challenged on several grounds. Ethnographically described foragers may be a biased sample that only continued to exist because they occupied marginal habitats less coveted by agricultural people. In addition, many foragers have been greatly influenced by their association with more powerful agricultural societies. It has even been suggested that Holocene foragers represent a new niche that appeared only with the climatic changes and faunal depletion at the end of the last major glaciation. Despite these issues, the ethnographic record of foragers provides the only direct observations of human behavior in the absence of agriculture, and as such is invaluable for testing hypotheses about human behavioral evolution.

There are no discrete hunter-gatherer groups in Pakistan. Thus, there is no study on surviving foraging communities. In India there are some ‘tribal’ groups that are often considered as the remnants of hunting-communities. Quite a few studies on them are available but they are either genetically oriented, trying to prove or disprove their origins separate from the ‘caste’ Hindus, or are suspect from methodological point of view. Thus, practically nothing is available that pertains to the present discussion there either. In view of this situation, paleoanthropologists working in South Asia have to rely on the ethnographic studies undertaken in Australia, oceania, and Africa.



Social Structures: Judging from the surrogate studies on living hunters-gatherers groups, their social character was determined in each locality by the scarcity and uncertainty of food supply. In such conditions sharing of food becomes an imperative as a social characteristic of the band. Food could not be preserved or even stored. If food cannot be preserved, it must be eaten fairly soon. This means sharing any surplus. This is not peculiar to humans as many animal groups also share their

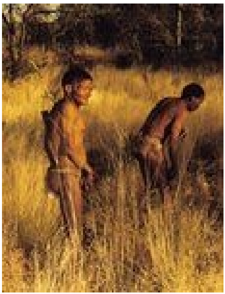
surplus. In primitive human groups which go beyond the stage of utter scarcity the sharing eventually became a social obligation. Secondly, foodgatherers rarely collect or kill more than they can use for lack of preservation and even storage. Third, each human group favored some special food, which later on started to be associated with that group as its totem food and apparently gave rise to gathering or hunting rituals so eloquently depicted by the cavemen on rocks in several parts of the world.

It has been observed that sharing is to be done on terms that involved no other obligation than reciprocate sharing at some future date. Those who shared therefore formed a group, and specialization in the procurement of food made them into a clan, often bound by a food-totem. When the surplus increased, the group as a whole would naturally own it, and the exchange would be with some other group gathering perhaps some other special food. This implies relationship between those making exchange, which must necessarily be a group rela



tionship, often group marriages. The group languages with their limited vocabularies mingled, and new languages with improved vocabularies emerged. Thus, the exchange-kinship relation not only increases the food supply but also improves the language and enlarges the mental horizon of the coalescent groups. According to the accepted reconstruction, the exchange between totem groups led also to the exchange of persons, i.e., to some form of ‘marriage’ relationship. The remnants of such an exchange are still seen in a number of primitive societies in Pakistan as well as in neighboring India and Afghanistan where girls are regularly exchanged between clans and tribes and was a normal way of cementing relationships between social groups up to medieval times all around the world.

As food sources are invariably seasonal rather than equally available throughout the year, and also occur in clumps or patches rather than being equally distributed across the territory, most foragers are mobile, moving from food source to food source within their annual territory. However, they are not 'nomadic' in the sense of moving about



in an unplanned way. Movements are carefully scheduled or structured to take advantage of seasonal fluctuations in the availability of food sources.

Normally associated with mobility are concepts of shared property. Movable property is usually owned by individuals, but if land is owned (and this concept is alien to many forager societies), it is owned collectively by a kin group. In some societies the whole group has unrestricted access to all the land within the group's territory, in others access may be more restricted to kin groups, but in such cases marriage alliances and rules of reciprocal access tend to achieve much the same result. As an example, this system of common ownership by clans or larger tribal group is epitomized in modern times by several population groups in tribal area of the Pashtun country in the northwest of Pakistan and southeast of Afghanistan. We even detect its ethos even in modern, settled societies at large in

certain areas of Punjab.

Ithasbeen established rather conclusively that bands of prehistoric huntergatherers generally moved within close proximity. They confined themselves to restricted areas for their foraging and hunting activities a n d g e n e r a l l y avoided forays into strange lands in

their neighborhood. Steady climatic conditions allowed them this luxury. Because of a small population, only limited information between the mobile bands took place and human development was generally regional, as evidenced from the shape and form of their stone tools, as well as the raw material which they used to fashion these tools. In Pakistan, this regionalization explains the vivid differences between the stone tools discovered in the Pothwar region on one hand and those in the neighboring northwestern India on the other. A similar example is the difference between the material, shape, and the tool-technology of Sindh and those of the neighboring Gujarat.

We do not have much archaeological data from the western borderlands but we assume that the contemporary cultures that were developing in Afghanistan and the rest of the central Asian region were considerably different than that prevailing in Pakistan. This cultural and technological regionalism apparently was carried over to the time period when man in fact became sedentary and started to subsist on agriculture and pastoralism. The characteristic remains of early settlements point to such a regional differentiation. It was rather late in prehistory that different regions began to interact with each other and some common cultures started to develop over large areas of human abode.

It is evident that in such small, continuously moving communities, there is little opportunity for economic or other kinds of specialization to develop. What one person knows and believes, the entire group tends to know and believe. Life is communal: cultural and technological knowledge and skills are widely diffused. A rough egalitarianism tends to prevail, and there are no sharp social distinctions. Some individual may enjoy more status than others on the basis of age, skills, bodily

strength, and “leadership qualities”, but there are few, if any, class distinctions. Custom and tradition, which are learnt by imitation or embodied in the legends and myths of the band, determine behavior and values. The rules are simple and clear and understood by all. Social pressure by the group enforces proper behavior. There is little need for coercion.

This type of society has been characterized as ‘pre-class’ or ‘class-less’ society. A peculiar characteristic of these pre-class societies is that they are matriarchal in character, father being of no importance, often not even recognized as having any procreative function. Matriarchal institutions still survive in those parts of the world that took last to the plough economy. The reason is that, originally, there existed no concept of property except for the few tools prepared by the individual, which supposedly contained some extension of his personality. Land was territory, not property; game and food



gathered was shared out to all. It was during the development of agriculture and pastoralism that people began to live more and more efficiently at the expense of their environment; man first produced a greater surplus by his labor than was necessary to support the individual producer himself. Thus, patriarchy, individual property, class division became possible, though not always inevitable.

This conceptualization of egalitarian society is, however, not universal and many forager societies do not fit the flexibility, mobility, and social equality, described above. Some of the sedentary forager societies of the north-west coast of North America, for example, were divided into chiefs, commoners, and even slaves. Most of the tribals in India fit in this mold where the caste system of social norm divides the society into endless stratifications. The concept of common ownership is either absent altogether or is subservient to the class structure. It is argued that in normal circumstances of an egalitarian society the construction and ownership of specialist equipment could favor differentials in access to resources: 'a fish trap involves considerable labour, and the trap and its catch will therefore belong to those who constructed it'. The actual situation in socially stratified societies, such as those in some tribals in India, is, however different and, surprisingly, the person or the family who constructs the trap still remains subservient to the upper class, akin to an agricultural society where owenrship carries more weight than the labor. In some cases, the social stratification originates neither through superior labor nor purely owner ship of resources. Instead, its basis is the custom and belief. Since such a social behavior flies against all theoretical models, it is argued that it

has been acquired in more recent times through the contacts of these foragers with the settled agriculturists who came to reside in their vicinity. This argument makes a lot of sense and seems to have some historic validity.

It has been observed that young people usually marry outside the band. This preference not to marry within the family or even the band was obviously not a result of any religious teach ings, but rather a biological response. There was a genetic advantage in marriage-exchange. In



termarriage in



creased the vigor of
the offspring to a level
above that of both
parents. The sudden
proliferation of better
grade tools and supe
rior adaptability to the
environment during
the late Middle Paleo
lithic in lower Punjab
and elsewhere proba
bly was the result of
such intermarriages
between the *Homo
erectus* and the newly
arrived *Homo sapiens*
from the west. The
advantages were
probably not the result
of experiment, plan
ning, or reasoned ac
tion. Those groups

A particular social group or band inhabited the same tract of country year after year. In general, the greater the abundance and security of food supplies, the smaller the territory needed for a given group of foragers, and the higher the population densities. In some societies the bands defended the area they exploited, whereas in others access to resources was less controlled and band territories overlapped.

Evidence for interpersonal violence, raids, and blood-feuds, endemic amongst many agricultural societies, is surprisingly common amongst modern foragers, in contrast with the world of 'caring sharing' foragers portrayed by much of the anthropological and archaeological literature (1). In general, records of violence amongst recent foragers refer especially to periods just before and during colonial pacifications, and the extent of violence amongst these societies before colonial contact is less clear. Nevertheless, the archaeological record suggests that interpersonal violence has been more that adopted the new scheme of exchange increased in numbers and efficiency; the rest were driven to extinction.

Climatic changes, over and above the longterm Ice Age changes, sometimes did occur. If these bands of hunters-gatherers could no longer subsist on the available supply of food within their area of habitation, they moved larger distances to new areas in search of reliable sources of food. These long distance migrations seem, however, the exceptions rather than the rule. When long distance migrations did occur once in a while, they seem to be confined within a specific area, which was seemingly defined by the ease of migration and the availability of water-containing routes. This explains the reasons that the stone tools of Paleolithic Pakistan in general have more affinities with those of the west, with which it had an easy connection through various passes, rather than with the east from which this land was cut off by a vast desert in between. or less endemic, certainly since the

Upper Palaeolithic (8), and the archaeological record of many regions of the world frequently contains evidence for violence amongst transitional forager-farmer societies, most commonly in contexts of developing semi-sedentism or sedentism and related demographic stress (3). Such a position, however, has not yet been tested and may not stand to a close scrutiny.

A vast amount of ethnographic and archaeological evidence demonstrates that the sexual division of labor in which men hunt and women gather wild fruits and vegetables is an uncommon phenomenon among hunter-gatherers worldwide. Although most of the gathering is usually done by women, a society in which men completely abstained from gathering easily available plants has yet to be found. Generally women hunt the majority of the small game while men hunt the majority of the large and dangerous game, but there are quite a few documented exceptions to this general pattern. A study done on the Aeta people of the Philippines states: "About 85% of Philippine Aeta women hunt, and they hunt the same quarry as men. Aeta women hunt in groups and with dogs, and have a 31% success rate as opposed to 17% for men. Their rates are even better when they combine forces with men: mixed hunting groups have a full 41% success rate among the Aeta (18). It was also found among the Ju'hoansi people of Namibia that women helped the men during hunting by helping them track down quarry (95). Moreover, recent archaeological research done by the anthropologist and archaeologist Steven Kuhn from the University of Arizona suggests that the sexual division of labor did not exist prior to the Upper Paleolithic and developed relatively recently in human history. The sexual division of labor may have arisen to allow humans to acquire food and other resources more efficiently. It would, therefore, be an over-generalization to say that men always hunt and women always gather. It is more of a relatively recent human "invention" that by increasing efficiency was beneficial to both sexes.

At the 1966 *Man the Hunter* conference, anthropologists Richard Brochette Lee and rIven DeVore suggested that egalitarianism was one of several central characteristics of nomadic hunting and gathering societies because mobility requires minimization of material possessions throughout a population; therefore, there was no surplus of resources to be accumulated by any single member.


Enjoying a free drink in an 'original affluent society' of Sahlins

Other characteristics Lee and DeVore proposed were flux in territorial boundaries as well as in demographic composition. At the same conference, Marshall Sahlins presented a paper entitled, " Notes on the Original Affluent Society, in which he challenged the popular view of hunter-gatherers living a "solitary, poor, nasty, brutish and short, life" as Thomas Hobbes had put it in 1651. According to Sahlins, ethnographic data indicated that huntergatherers worked far fewer hours and enjoyed more leisure than typical members of industrial society, and they still ate well. Their "affluence" came from the idea that they are satisfied with very little in the material sense. This, he said, constituted a

“Zen economy (96). These people met the same requirements as their sedentary neighbors through much less complex means.

Human hunter-gatherer group structure is unique among primates, according to new research by anthropologists who studied data from 5,000

individuals in 32 present-day foraging societies. (97) . One of the most complex human mysteries involves how and why we became an outlier species in terms of biological success. Contemporary humans exhibit spectacular biological success derived from cumulative culture and cooperation. The origins of these traits may be related to our ancestral group structure. Because humans lived as foragers for 95% of our species’ history, hunter-gatherers display a unique social structure where (i) either sex may disperse or remain in their natal group, (ii) adult brothers and sisters often co-reside, and (iii) most individuals in residential groups are genetically unrelated. These patterns produce large interaction networks of

unrelated adults and suggest that inclusive fitness cannot explain extensive gatherer bands. However, may help to explain why humans evolved capacities for social learning that resulted in cumulative culture.

Their finding showed that across all groups, adult brothers and sisters frequently live together, making it common for male in-laws to co-reside. They also found that it was equally common for males or females to move from or remain with family units. This is in contrast to other primate species, where either males or females move to another group at puberty. A major point in the study (97) is that foraging bands contain several individuals completely unconnected by kinship or marriage ties, yet include males with a vested interest in the offcooperation in hunterlarge social networks spring of daughters, sisters and wives. This organization mitigates the group hostility frequently seen in other apes and also promotes interaction among residential groups, thereby leading to the development of a large social network.

Demography: Because of their mobile way of life and their methods of subsistence, hunting and gathering economies can support only a low child-to-adult ratio. Interestingly, the birth rate of such groups tends to remain low: there appear to be natural checks on fertility, so that the population tends to stay in balance with available resources. The woman cannot have another child to carry until the current babe-in-arms can walk from camp to camp unaided, usually at about two years of age. Hence foragers are commonly described as practicing a variety of behaviors in order to keep their numbers down, including long lactations and related intercourse taboos, contraception, and in the last resort infanticide. Numbers are also kept down by the heavy workload women undertake, the young age at which they first bear children, the lack of nutritional weaning foods, and the hazards of childbirth.

Accurate demographic data on foraging societies are hard to come by, but a recent survey found a wide range of fertility and survival rates (9). Population simulations indicate that forager populations are more likely to be characterized by cycles of boom and bust than stability or very slow growth, with boom times balanced by periods of epidemics and famine reducing survival to the worst levels, creating near-zero growth. The survey indicated that healthy forager women were producing 6-8 births in their lifetime, but that infant mortality was usually high. The survival rates of mobile !Kung-San and Hadza bands are particularly low - only about half of newborn children survive to age 15 - whereas amongst recently settled groups of !KungSan and Ache (Paraguay foragers), the chance of surviving to age 60 is better than 50 per cent.

Population densities among hunter-gatherers are dependent not only on the supply of food but also on the severity of environment. In extreme environments, such as the Arctic or the Australian desert, forager population densities may be less than 0.1 person per square kilometer. At the other extreme, densities of 50-100 people per square kilometer are known to have been sustained by some semi-sedentary coastal communities in North America that were reliant heavily on fishing.

Estimation of world population of huntergatherers at any fixed point in time is difficult but it has been an article of faith among archaeologists and anthropologists that world population growth before agriculture was extraordinarily slow compared to growth rates afterward. The stable population size, which tends to characterize huntersgatherers, points to one of the most fundamental differences between this mode of life and the more complex way of life based on agriculture and settled lifestyle.

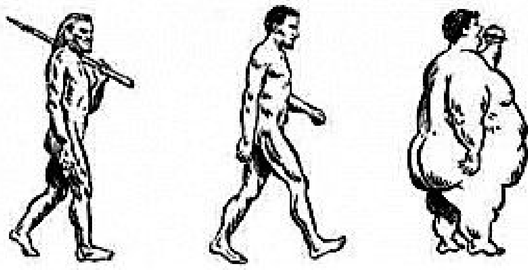
Archaeologists have found that climate is a crucial determinant of prehistoric population. This is true both for colonization of new continents and for population density at the local and regional level. Until the onset of the Holocene about 12,000 years ago, climate shocks were large, frequent, and had massive effects on natural resources and population levels across much of the world. The role of technology is also important in any discussion of paleolithic demography but to make a strong case for technological progress, one would need to show that population density increased within a fixed geographic region with fixed natural resources, and that this increase was not driven solely by migration. This is, of cpurse, an impossible task.

Some archaeologists are skeptical about the significance of “population pressure” in human social evolution (58,59), but most continue to think of demographic factors as one of several ingredients necessary to the forager–farmer transition. Densitydependent effects can play decisive roles in shaping the evolutionary histories of predator–prey systems in general, and humans should not be altogether immune to these effects in principle. Changes in human population density certainly influence the rates of interspecific and intraspecific contact and the availability of critical foodstuffs. Under these conditions, people’s solutions for getting enough to eat are bound to shift as well. Rapid technological change and increased densities of archaeological sites during the later Paleolithic lend some credence to this position.

Population growth has been shown to be a particularly important factor in the Mesolithic transition, which represented a significant growth in population throughout the Old World. This is evident from the fact that sites of this period are much larger in number than those of the preceding Paleolithic stage. Interestingly, this growth in population has been universal and it seems to be connected with favorable climatic conditions and a resulting increase in food supply.

As the Holocene progressed, it was but natural that an impressive increase in population first occurred in areas of higher population density, such as the Quetta Valley along the Bolan River, fringes of the Thar and the river banks in Cholistan. The northern areas took considerable time to repopulate and join the march to the Neolithic.

VIII.2. Paleolithic Diet through the Ages



Human nutrition researchers are increasingly exploring the role evolution has played in the development of modern human physiology and are becoming aware of various nutritionally related disorders in modern societies that are not observed in a number of modern hunter-gatherer populations. This has led a number of researchers to conclude that humans are maladapted to diets of domesticated and processed plant foods as these foods are recent in evolutionary time-scales. A general impression has thus grown that much of the modern diet is suspect - often dominated by over-processed foods. Logically, then, we might turn to the past to find the foods that our species evolved with. It is tempting to think that by going back further we will get closer to the ideal.

Although the guiding principle is most likely true - that we can learn from the deep past - archaeologists and paleoanthropologists have uncovered a picture far more complex than the popular media presents. An outline sequence of events, a timescale, and in particular knowledge emphasizing that the past was highly varied, and that human ancestors made a multiplicity of adaptations through millions of years, is the reality. An auxiliary question is: If the human diet changed through the Stone Age, then what was the cause and effect, and how this change was related to the cultural change to vice versa.

This chapter is to briefly introduce the reader to the methods archaeologists use to infer past human and hominid subsistence, as well as to provide a brief overview of the existing evidence for human subsistence from the rise of our line in Africa *ca*. two million years ago, up to the first adoption of agriculture approximately 10,000 years ago. This inquiry, of course, ties up with the concomitant changes in culture and technology that various human groups went through during this time period. Part of this review takes advantage of a similar attempt by M.P. Richards (22) from which several paragraphs have been here extracted.

Tools for Reconstructing Past Diets: Archaeological sites dating to before 10,000 years ago are rare, and many of the artifacts that were present when the site was formed have disappeared through time. The organic remains of food consumption are among our best evidence of past subsistence, but rarely survive. Plant remains are missing from a large part of the archaeological record, but when they are present it may be possible for specialists, archaeobotanists, to identify species present, including domesticated *vs.* wild species (23). Bone, however, often does survive, and zooarchaeologists can determine the species and number of individual animals in a faunal assemblage (24). Through careful study of bone taphonomy and natural bone deposition processes (i.e. by carnivores) it is possible to identify human-modified animal bone that is the result of purposeful butchering and hunting in the past. Animal and plant remains are indirect measures of past diets, and may relate to single events, such as a special feast, but we cannot know how representative of everyday diets they are.

Direct methods of dietary reconstruction, on the other hand, focus on the study of hominid remains directly, and have the potential of telling us about daily subsistence. Earlier hominid bone remains are rare, but when found provide a wealth of information on past diets, particularly through analogy with modern primates (e.g. mandible size). Osteoarchaeologists look for evidence of nutritional health as manifested in the skeleton, and look for pathologies that indicate nutritional stress. Our newest tool for reconstructing past diets lies in the chemical analyses of these hominid bones, particularly stable isotope analysis, which provides a direct measure of these past diets.

A Brief Summary of Hominid Evolution: Almost half of this book, directly or indirectly, deals with hominin evolution. It is, therefore, not necessary to rehash this subject any more. Nevertheless, a brief summary would not hurt, especially if it could provide an appropriate introduction to the discussion that follows.

The first hominids, including the Australopithecines, first appear in Africa approximately four million years ago and the link between the various species remains complicated and controversial. These early hominids probably walked upright, and had robust cranial features, including massive mandibles. Homo *habilis*, believed by many to be the first species in our line, first appears in Africa approximately two million years ago. There is evidence the first purposeful use of stone tools is linked with the appearance of this species, and this trait is therefore believed to be unique to the *Homo* line, although others argue that the latest Australopithecines could also have been tool users. As our line evolves through Homo *ergaster* to Homo *erectus*, we see the spread of hominids, for the first time, out of Africa and into Eurasia. Within the *Homo* line we see a decrease in mandible size and an increase in cranial capacity through time. These trends continue into the more recent past and, focussing on Europe specifically, we find Neanderthals between about 200,000 and 30,000 years ago with the largest cranial capacities of any hominid species. A similar evidence comes forth from the Far East. Modern humans, Homo *sapiens sapiens*, first appear approximately 100,000-150,000 years ago in Africa and spread over much of Asia from approximately 70,000 years ago. Pakistan and the surrounding regions were probably colonized by modern humans around the same time. Europe was rather late in colonization by the moderns which did not happen till 40,000 years ago.



What is the evidence of subsistence changes through these four million years of hominid evolution? We have three lines of evidence that have been used to reconstruct the evolution of subsistence over this vast time period. They are the interpretation of morphology by analogy with living primates and other mammals; the material artifactual remains; and, more recently, direct chemical analysis of the hominid remains themselves (22).

Morphological and Dietary Changes in the Hominid Line: Most of our interpretation of the lifestyles of the earliest hominids derives from the study of living primates such as gorillas and chimpanzees. The deep background of humanity can be traced back some 10 million years, among ancestors of our closest relatives, the great apes. Biochemically - in our DNA and proteins. In the evolutionary sequence of descent, humans are most closely related to the chimpanzees and bonobos, slightly less so to gorillas, and less so again to orangutans. The apes are varied in adaptation, but fundamentally are rainforest animals. Apes have a diet based largely on fruits. Gorillas eat more leaves, such as wild ginger herbs, and also a proportion of bark and pith (25), whereas in addition to a high content of fruit, such as wild figs, chimpanzees eat substantial components of insects and meat gained by hunting. Hundreds of cases of chimpanzee hunting have been observed, generally of monkeys, but sometimes of baby antelope or baboons. Chimpanzees are the most closely related to us, and they, especially the common chimpanzees, eat less leafy material and are more omnivorous, adding in, for example, honey and eggs..

It seems intuitively obvious that the diets of closely related primates might give some indication of the evolutionary basis of human diets. Thus, anthropologists have studied the dietary habits of gorillas, orangutans, chimpanzees, and other hominoids in the wild through patient observations as well as examinations of teeth, stomach contents, and faeces. These investigations suggest that gorillas are almost exclusively herbivorous, but other species use animals as food in amounts up to 15% of the diet by weight. Although the structure of the primate digestive tract suggests that the predominant foods should be plants, evidence also indicates that these animals eat whatever is readily at hand (17) – plants, but also insects, eggs, crustaceans, and carrion. Overall, nearly 70% of primate species eat some animal foods but we cannot assume from such observations that primate diets establish a genetic basis for an optimal human diet (17).

Recent finds show that hominids (the family of human ancestors) diverged from ape ancestors probably 8–10 million years ago. DNA differences between existing species can be calibrated to suggest dates for a last common ancestor with the apes as recently as about 5 million years ago (26), but recent discoveries of very old hominid fossils in Kenya and in Chad show that the biochemical evidence underestimates the real divergence date.

The hominids are likely to have developed in drier environments than those inhabited by modern apes, becoming successful enough to generate their own adaptive radiation, leading to a ‘bush’ of new species. As a group they are recognizable by changes in their teeth and in locomotion habits, both probably associated with life in bushland rather than in the traditional ape rainforest habitats. Changes in their teeth indicate diets involving heavier chewing on the molar teeth, coupled with a reduction in the front dentition (already seen in the recent finds of *Sahelanthropus*, dated to 7 million years). The canine teeth are strongly reduced compared with those of chimpanzees. These characteristics are emphasized in Australopithecus *afarensis* of 3–4 million years, which has a complex of large molars, with M3 as the largest. Upright walking or bipedalism concerns us less directly, but may also be linked with changes in feeding habits (27). Hominids may have had to stand up, reach out, and range for food more widely than their rainforest cousins.

Comparisons of diet with living apes and modern peoples using similar ranges of plant foods in Africa suggest that a major factor in the change was adoption of roots and tubers in the diet. This addition to the diet was probably necessitated by the need to gain food at all times in a more seasonal environment (the savannah), and it places starchy carbohydrate consumption as part of the deep

ancestry of human beings. The size and shape of teeth suggest that the pattern of heavier chewing was already in place 3 million years ago.

Early hominids such as the Australopithecines and the recently discovered *Kenyanthropicenes* (28) are characterized by relatively massive mandibles, and the more robust species have significant muscle attachments, such as sagittal crest on the top of the skull. These features are also found in gorillas, who have an entirely vegetarian diet and require the large mandible and strong cranial muscles for the crushing and grinding of plant foods. These features are less pronounced in subsequent species such as the more gracile *Australopithicus africanus*, and the larger-brained *Homo habilis, ca* 2.5-1.8 million years ago (29).

Homo habilis is a relatively gracile species with cranial features more in common with chimpanzees than gorillas. Chimpanzees do consume some animals, including insects, and therefore have less need for the more expensive, in terms of energy costs, robust crania and mandibles, and this is the type of subsistence suggested for *Homo habilis*. There is another trend in time, the concomitant increase in brain size as reflected in cranial capacity. Again through analogy with modern primates like chimpanzees, this increase in brain size has been linked to increased intelligence, which, in turn, implies the increasing use of tools for the collection and processing of foods.

As we move into the last million years of hominin evolution, there is only one generally accepted hominin species, *Homo erectus*, which first appears in Africa *ca* 1.8 million years ago. With this species we probably see the first movement of our line out of Africa which required the ability to adapt to a range of climates, which, in turn, implies a dietary breadth and flexibility that was not present in earlier species. From approximately 200 000 years onwards, and perhaps as early as 400 000, archaic *Homo sapiens* are first found. A variant of these, the Neanderthals, are first found in Europe from approximately 130,000 and last until approximately 30,000 years ago (30). Neanderthals are robust, stocky hominins, which is believed to relate to an adaptation to the cold climate of Europe (31). Homo *sapiens sapiens* probably appeared in Africa approximately 200,000 years ago, and then spread the Old World, appearing in Europe approximately 40,000 years ago (32,33). However, this replacement model has been criticized by proponents of the regional continuity model (34).

There are two main morphological trends through time in the evolution of the hominid line, increasing gracilization of the mandible and other cranial features, as well as an increase in cranial capacity. Many researchers interpret this mandible gracilization as being due to an increasing consumption of meat, which is less fibrous than plant foods and therefore easier to masticate. As discussed above, this inference is derived from comparisons between fossils of extinct hominids and crania of living primates whose diets are known. Researchers have also argued that there is a link between meat consumption and the second temporal trend, increasing brain size through time (35,36).

The main inference is that larger brains mean greater intelligence. These larger brains are expensive in terms of energy needs, but were necessary for hominins as they allowed us to outcompete our competitors through increasingly complex culture and manipulation of the environment. The higher energy needs these larger brains required could be met by the consumption of meat, which is a more energy-efficient food than plants. The main recent proponents of this theory in the anthropological literature are Leslie Aeillo and Peter Wheeler, who published a paper in 1995 in *Current Anthropology* entitled 'The expensive tissue hypothesis'. They argue that our brains are much larger than we might predict, using ratios of expected organ masses to brain size for other mammals, and

this increased brain size is due to increased needed intelligence, and the energy expense this incurs can best be met by the consumption of high-energy animal meat rather than plant foods. Their assumptions also infer an associated reduction in the size of the gut of our hominid ancestors, through time, to compensate for this increased brain size. Eating less plant food and more meat means our digestive systems do not have to work as hard, which allows this decreased gut size. The increased brain size, and therefore intelligence, allows us to manipulate our foods in ways that no other animals can, so intelligent hominins can use tools to cut up meat, as well as cook and further process foods, which also makes them easier to digest in our smaller guts.

Among human ancestors, meat became more important around 2 million years ago, as documented by associations of stone tools and bones with cutmarks (37). Meat eating would have been more necessary in colder environments, where alternatives were limited. We now know that early humans had colonized temperate latitudes by about 1.7 million years. At this date, remains of early Homo are found at Dmanisi in Georgia, associated with stone tools and a non-African range of fauna (38). Both the range of plant foods and their seasonal availability were more restricted in the north. Here, too, human populations were exposed to cyclical climate changes of the ice ages. Hominids may have expanded their range in cool times when vegetation was not closed and dense, but when it was not an extreme of ice age cold. Steppe environments hosted very rich faunas, including mammoth and woolly rhinoceros.

Fire would have been useful to early humans, for warmth and protection, but also for cooking. We think obviously of cooking meat, where fire saves us some of the energy costs of digestion, but it may have been equally important for dealing with starchy foods. About half of the roots and tubers used in sub-Saharan Africa are indigestible without cooking (39). Unfortunately, dates for initial fire use are uncertain, in a range 1.5 to 0.5 million years.

Another fruitful line of evidence for early hominid diets is from analogy with modern humans, rather than other living primates. In a recent paper Cordain et al, (40) argue that the observed increased brain size through time in the Homo line requires the consumption of animal products. They point out that there are two essential fatty acids, docsahexaenoic and arachidonic, that are essential to brain development in modern humans, and the best sources of these two fatty acids are bone marrow, and particularly ruminant brains. Therefore, the consumption of these animal products would have facilitated expansion in brain size and increased cranial capacity over the long term. Similar arguments regarding omega-3 fatty acids are presented by Chamberlain (41,42).

The above arguments, that the morphological changes in hominin crania can be explained by the increased consumption of animal foods through time, is strongly contested by researchers such as Milton (20). They argue, by analogy, that the majority of living primates are largely vegetarian, and that we, as primates, are best adapted to a mainly vegetarian diet. Milton writes that mandible size decreased due to the increased consumption of energy-rich plant foods such as fruits, and not necessarily meat. The complex skills required to harvest these energy-rich plants would also result in a selection for more intelligent hominins, with resulting increased brain size through time. This alternative hypothesis highlights the inadequacy of the use of analogy with living primates as a means to understand hominin subsistence, as the same lines of evidence can be used to support two opposing views. Clearly, additional lines of evidence are needed to resolve these two alternative explanations

On the basis of wear-and-tear patterns on fossilized jaws and teeth, early hominids must have eaten

fleshy fruits and leaves from heavily wooded habitats, although later hominids who lived in savanna environments were likely to have been omnivorous. Because the ratio of stable isotopes (e.g. C^{13}/C^{12} or O^{18}/O^{16}) reflects what vertebrates have eaten (15) researchers can now provide direct isotopic evidence for some aspects of the dietary patterns of early homans. Their studies reveal that progenitors of homo *sapiens* must have eaten fruits and leaves but also large amounts of foods enriched in C^{13} such as savanna grasses, or the animals that ate such grasses (44). This finding is especially interesting because it suggests that early hominids were eating animals before they could make tools. It also suggests that because meateating occurred long before the human brain increased to its present size, this dietary practice cannot be responsible for the development of larger brains. One additional piece of evidence comes from findings at a European cave where investigators observed similar cut and fracture marks on the bones of deer and hominids, suggesting that Neanderthal hominids not only ate meat but also each other (45).



An artist’s impression of a boar’s kill in the late Pleistocene or early Holocene period. Archaeological evidence shows that such animals were rampant in Pothwar and

probably also in Baluchistan.

An alternative dietary hypothesis to explain this transition is that consumption of tuberous vegetables (‘underground storage organs’) could have raised energy intakes and promoted longer lifespans (46) especially when the tubers were cooked and made more digestible (47). This tuber hypothesis has elicited much debate about whether any foods could have been cooked two million years ago, as most evidence for the use of fire for cooking purposes suggests a much more recent date – 250000 years ago (47). Clearly, early hominids ate meat as well as plant foods, but in relative proportions as yet undetermined.

Neanderthals are the second most studied bominin species after our own and yet many of the ecological and behavioral facets of this species are not well understood. Perhaps a major historical stumbling block has been an overemphasis on gauging the physiological and bebavioral aspect of this species against those of the Upper Paleolithic anatomically modern humans which eventually replaced it. Much emphasis has also been placed on debunking the traditional view of Neanderthals as a brutish, maladaptive species which failed to compete withmodern humans over the same habitats. We now know that Neanderthals successfully adapted to the fluctuating climatic conditions of the last glacial and at some stage of their existence have managed to extend their geographic distribution as far east as the Altai Mountains, even to Afghanistan.



A herd of wild goats (Markhore) in a protected area of north of Pakistan (Gilgit). Such herds of related animals are also indicated in Sindh and Baluchistan during the Mesolithic transition.

A similarly wide range of plant food was available in parts of the Middle East and Asia.

In contrast, modern humans entering Europe 40,000 years ago would have adopted a meat-based diet by necessity, and maintained this over hundreds of generations. Paleolithic cave art of Europe centers very heavily on the representation of animals. Modern hunters and gatherers echo the variety of past diets, ranging from largely plant based in the tropics, to being also heavily meat based in the arctic.

There can be little doubt that the ancestors of most Europeans had such a meat-based diet for approximately 30,000 years of ice age (40,000– 10,000 before present), some 1200 generations. From 10,000 years ago, climatic improvement led to warm-period hunting and gathering, probably involving larger components of roots and berries. Then

Our perception of Neanderthal hunting abilities has drastically altered during the past decade as a consequence of arcbaeozoological studies of Middle Paleolithic assemblages. These studies indicate that Neanderthal subsistence varied by period and region with evidence of both competent big game bunting, often with a clear focus on prime age adults of a narrow number of ungulate species, and the adoption of a broad spectrum subsistence range which includes frequent hunting and possibly trapping of small game. Additionally, stable isotope studies confirm that meat played a major role in Neanderthal diet, as expected in the case of a species which occupied the high-latitude and highaltitude regions of Eurasia.

Ancestors of modern humans are believed to have evolved in the tropics, probably in Africa, from about 200,000 years ago. Their diet was, therefore, probably largely (perhaps 70%) plant based like that of modern hunters and gatherers in the region (20). farming came in, so that cereals and milk have been major products for the last 5000 years, or 200 generations.
Recent evidence shows that by 50,000 years ago, humans were highly adapted even to extremes of arctic cold. Many archaeologists have wondered whether early (and therefore putatively primitive) humans could have hunted large animals successfully. It is hard to see otherwise. The reality is that if early humans were there at all, they had to survive through conditions which would seem terrifyingly harsh to their armchair detractors. Stable isotope analyses of carbon and nitrogen in bone collagen now show Neanderthals to have been carnivores to a very high degree (43) Agriculture began from about 10,000 years ago, in several centers of domestication

around the world, notably the Middle East. A consequence of adopting staples, especially cereals, was that people reduced the range of foods consumed, although initially domestication may have involved a wide range of plants, some valuable for their fatty acids. The intensive use of many seeds probably became possible only when the use of grindstones and cooking rendered them more palatable. Agriculture has spread steadily from its beginnings, but in some parts of the world it arrived only within the last 2000 years, and so we can wonder how far populations have been able to adapt genetically to diet change.

Barley (Hordeum vulgare L.) and wheat (Triticum monococcum L. and Triticum turgidum L.) were among the principal ‘founder crops’ of southwest Asian agriculture1. Two issues that were central to the cultural transition from foraging to food production are poorly understood. They are the dates at which human groups began to routinely exploit wild varieties of wheat and barley, and when foragers first utilized technologies to pound and grind the hard, fibrous seeds of these and other plants to turn them into easily digestible foodstuffs. Plperno et al (98) have reported the earliest direct evidence for



A tuft of wild barley. During the early Holocene, it grew all the way from the Mediterranean to the slopes of the Himalayas

human processing of grass seeds, including barley and possibly wheat, in the form of starch grains recovered from a ground stone artifact from the Upper Palaeolithic site of Ohalo II in Israel. Associated evidence for an oven-like hearth was also found at this site, suggesting that dough made from grain flour was baked. Their data indicate that routine processing of a selected group of wild cereals, combined with effective methods of cooking ground seeds, were practiced at least 12,000 years before their domestication in southwest Asia.

Material Culture and Dietary Changes through time: If we look at the more traditional archaeologic a l e v i d e n c e f o r hominid subsistence, it may be surprising just how little evidence remains. Organic material, other than fossilized bone, are extremely unlikely to survive in the distant past, and therefore we do not have any plant or animal remains from the majority of the four million years of hominid evolution. One artifact type that does survive is stone tools and these can

probably be used to draw some, although very limited, conclusion about the subsistence regime of the Stone Age peoples. As discussed earlier, the first tools that can be demonstrably shown to have been purposefully created by hominids are the simple Oldowan industry choppers and scrapers that appear in Africa *ca* 2.5-1.8 million years ago (29) and are widely believed to be associated with the first species in the Homo line. Analysis of the faunal remains and associated artifactual remains at so called 'home bases' from this time period in East Africa has led a number of researchers to conclude that meat-eating through hunting or scavenging did occur at this early period of prehistory, and this was associated with the Homo line.

With the appearance of Homo *erectus* we find an associated more complex stone tool industry, the Acheulian, characterized primarily by the ovate bifaces of various sizes that have been found throughout the Old World. The uses of the tools in these two traditions specifically for securing food is still not known definitively. Experimental archaeology, where modern replicas are made and used in a variety of ways, has shown that these tools, such as the handaxe, are remarkably diverse, and could be used to effectively butcher animals as well as cut up plant foods. Microwear analysis (48), where the pits and scrapes on tools are recorded with a microscope, has been used in a number of locations to infer the use of some of these early stone tools.These studies generally give mixed signals, indicating that most tools were used for a variety of purposes, or that the method is flawed, and can be confounded by the addition of new microwear after deposition.

Later stone tool traditions, such as the Mousterian, associated with Neanderthals, and the Upper Paleolithic, associated with modern humans, are more sophisticated. Their uses have been determined again experimentally, but also through analogy with stone tools used by modern, indigenous peoples. Although some of these more recent stone tools probably have multiple uses, the majority of them are clearly for hunting and butchering of game. This is supported by the very rare finds of hunting weapons embedded in the hunted animals, such as the wooden spear found embedded in a red deer skeleton from Lehringen, Germany (49), as well a Middle Paleolithic Levallois point in an Equus cervical vertebra from Umm el Tiel in Syria (50).

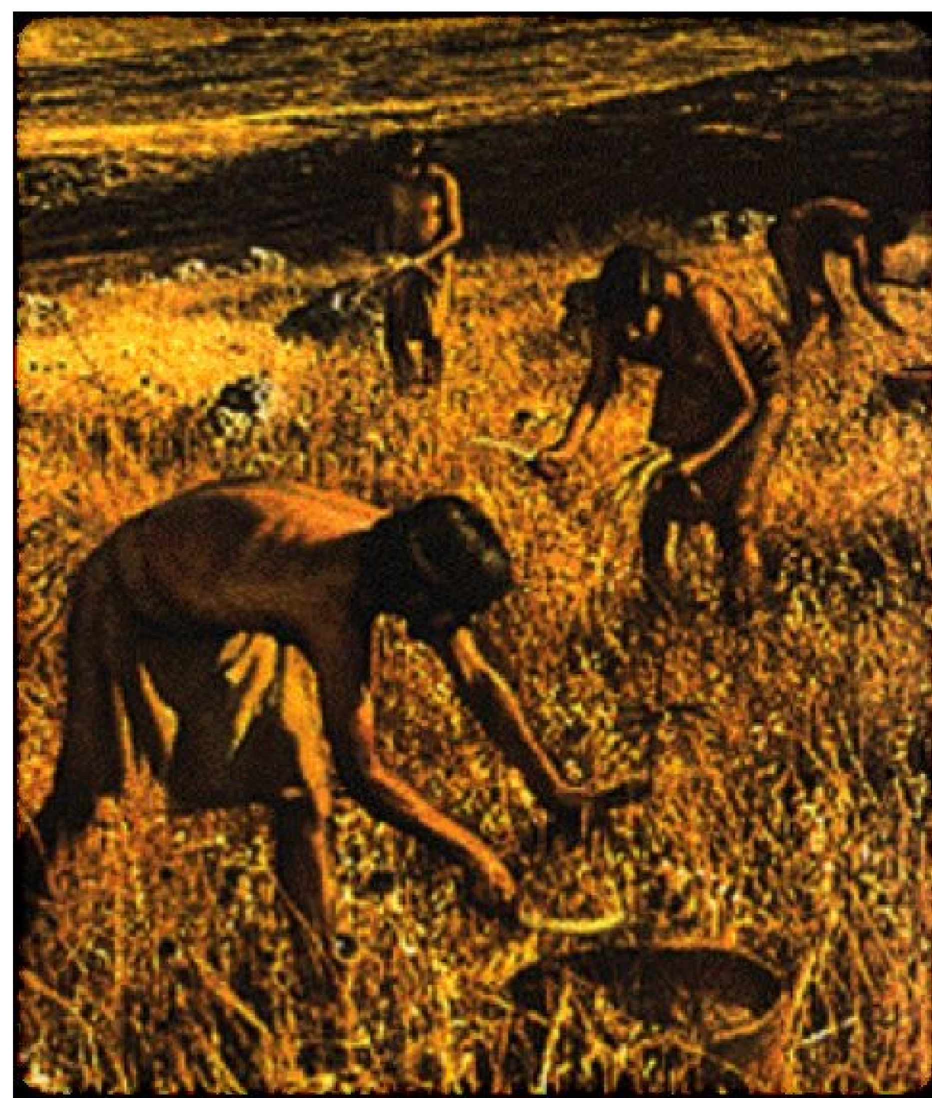
In these later periods we do start to find more organic materials in the archaeological record, and in particular faunal remains that show clearer signs of being hunted and butchered. For example, the remarkably well-preserved site of Boxgrove in Southern England, *ca* 500,000 years old, has a large number of Acheulian hand axes and associated faunal remains (e.g. rhinoceros and horse) that have cut marks on them, which are sings of being


An example of the Neolithic grinder

purposefully butchered by hominins (51,52). There are also other sites with remarkable preservation from the time period 500,000-300,000, such as Miesenheim and Bilzingsleben, Germany, and at Hoxne and Swanscombe, England. We have much more faunal evidence, from the Middle Palaeolithic (53), and a recent review of Neanderthal faunal assemblages showed the emphasis on the hunting and processing of larger herbivores.

What is missing from the archaeological record, even up to more recent time periods such as the Upper Paleolithic, is plant remains. They only rarely survive, and as they may not have required sophisticated stone tools to collect and process, we may not recognize the stone tools that may have been used to collect and process them.

To summarize, The archaeological record, consisting of stone tools and animal bones, is most likely biased and unrepresentative of the daily subsistence practices of hominids. Our inferences, from what we do have, is of a strongly meat-based subsistence, starting with the appearance of our line, *Homo*, in Africa, as evidenced by the remains of butchered animals and increasingly sophisticated stone tools



The woodland areas as well as the steppe offered a wide range of seed bearing grasses which was good food resource for human consumption

Dietary changes at the 'Neolithic revolution': App r o x i m a t e l y 10,000 years ago, associated with climate variation at the start of the Holocene, modern humans in the Near East began to cultivate plants, and later on to domesticate animals (62). This 'Neolithic revolution' led to an increase in population, sedentism and eventually to urbanization. The adoption of agriculture also occurred independently in other parts of the world, such as in Asia, where rice was the main domesticated plant (63,64,65), and in the New World, with the domestication of maize). We see the gradual spread of agriculture throughout the Old World. For example within a millennium or so, we observe the beginning of agriculture in the Queta Valley, Baluchistan, and a little later in Iran and throughout Central Asia.

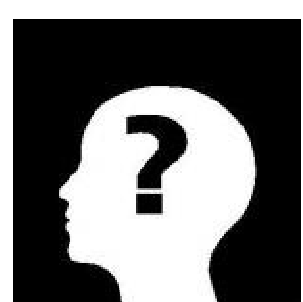
We have evidence for human control, or domestication, of wild plants and animals at the site of Mehrgarh, Baluchistan, by eighths millennium BC, by the senth millennium for sure. One theory is that the uncertainty in the availability of foods that the climate changes brought about may have led people to start to plant crops and raise their own animals so that they could be assured of a food resource, as they could no longer rely on wild foods that they would hunt and collect in this period of instability. Eventually they became dependent on the new domesticates, as their population sizes significantly increased beyond the carrying capacity of the local environment. A specific example of these changes is the site of Abu-Hureyra, Syria. In the latest Paleolithic period people relied on gathering plant foods and hunting gazelle (67). In the climate fluctuations of the Early Holocene they

could no longer rely on collecting wild plants so they start to plant their own; also, the gazelle slowly disappeared because of the climate change and probably from overhunting, so plant foods become a necessity as there are fewer animals to hunt. Domesticated animals such as sheep and goat began to replace hunted animals in the diets, but plant foods in the form of porridges and breads became the dietary staple.

The indirect evidence for this dietary change is in the archaeological record, with decreasing amounts of gazelle found through time, and then the appearance of domesticated sheep and goats, and also Th.e appearance of tools associated with grinding plant foods. The direct evidence for the changes in diet is from the skeletal evidence. Molleson (67). has argued that there are changes in the bones of women that are task-related and associated with cereal grinding, Also, there is a significant change in the dentition between the Paleolithic and the Neolithic. In the Paleolithic people have fairly healthy teeth with almost no caries, but in the Neolithic there is an increased use of plant foods which contain carbohydrates, so there is an increased caries rates. Neolithic teeth are also more worn down and pitted owing to hard inclusions from poorly ground-up flour.

The above discussion of the changes associated with the Neolithic have focused on the Near East specifically, but similar changes occurred in society in other regions (66), specifically Baluchistan (44). Focusing on morphology, there are changes in satture and caries rates with the introduction of agriculture, although these changes often were not manifested until the Bronze Age. There are increases in caries rates associated with the domestication of rice in South Asia, and an overall decrease in health and stature associated with the spread of maize agriculture into North America. There is often good archaeological evidence of subsistence associated with the adoption of agriculture, which is in sharp contrast to the sparse preagricultural evidence for diet as discussed above for the Paleolithic. For example, as agriculture was introduced relatively recently, it is common to find the remains of domesticated plants that have survived, especially at sites in dry environments, providing direct evidence of their domestication. We have stone tools that are inferred to be for plant processing, such as sickles and grinding stones, as well as pottery for the first time. In this respect, the site of

Mehrgarh at the borders of Sindh and Baluchistan in the Kachi Plains is of paramount importance not only for the study of early domestication of plants



and animals in Pakistan but also in connection with the Neolithic de**Recommended** velopments in South Asia as a

Paleolithic diet

whole.
“Paleolithic Diet”: All this evi



dence combines to show that there was a huge variety of Stone Age diet. A north–south cline was always the dominant factor. The climate cycles of the ice ages have also entailed colossal changes in environment in any one place. Ancient African and Southwestern Asian diets may have been close to optimal (in some views) involving large ranges of plant foods, supplemented by meat. But at many stages, human ancestors, including those of most Europeans, must have specialized heavily in a meat-based diet for hundreds of generations. As far as Pakistan is concerned, this region has been a part and parcel of Southwestern Asia and the diet of its ancient inhabitants must have been similar to that observed in the Near East.

Perhaps it is disappointing to underline that there was no one Stone Age diet. Yet the variety has its own interest, as we may be able to learn from it. Can any generalization be made? First, no ancient population would have been heavily dependent on milk or other dairy products - all that belongs to the last 5000 years. Second, a heavy dependence on individual cereal staples is also a recent phenomenon. Fruit certainly came first of all; but carbohydrates in the form of grain and roots are also an ancient component of diet. The general point is that in the past more species of roots and perhaps grasses would have been consumed, lessening the exposure to drawbacks from any one. 'Stone Age diet' is something of a misnomer, but the deep past does allow us to see which foods have been humanity's primeval companions.

The key question is: How long does it take a human population to adapt genetically to new circumstances and a new diet? We can reflect whether our biochemistry is now better suited to diets of 3 million years ago, 30,000 years ago, or 3000 years ago. It seems likely that biochemical evidence already exists which can provide many of the answers. From a general standpoint—even though some past populations have adopted specialized diets—many lines of evidence point to human ancestors having become omnivores. We can be reasonably sure that a broadly based diet sustained most of our ancestors for most of the course of human evolution.

Conclusions: To conclude, it is difficult to accurately determine the nature of past hominid diets, or define the 'Palaeolithic' diet, due to the limitations of the archaeological record, a problem which is amplified in the Palaeolithic period where survival of organic materials is very rare.

We can infer, based on changes in cranial morphology, such as increased gracilisation of the mandible and increase in brain size through time, that there is evidence for an increase in meat consumption in the *Homo* line through time. However, as this conclusion is based on analogies with living primates it is ambiguous, and the same data has been interpreted as being evidence of increasing use of energy-rich plant foods through time. Other lines of evidence are needed to address this debate, but perhaps the best interpretation of the morphological data is that hominids, and especially modern humans, have been very successful as highly adaptable omnivores, that probably had a significant input of animal products into their diets.

The artefactual evidence for diet is poor, especially from earlier periods. In Palaeolithic Africa and Europe stone tools have been inferred to have been used for hunting and butchering animals. Almost

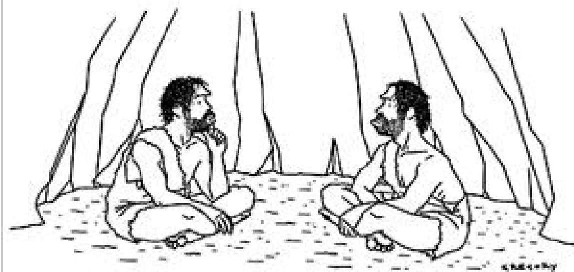
no plant remains survive, and animal bones have marks on them to indicate that they were butchered and hunted. However, there is a danger of placing too much emphasis on this evidence, as Marion Nestle writes 'Since bones are better preserved than vegetable matter, they give the impression that hunted animals must have been primary food sources' .

As a contrast, bone chemistry, especially stable isotope evidence, provides direct evidence of diets, and indicates, for the few limited studies, that Neanderthals were top-level carnivores. Two studies of Upper Palaeolithic modern humans in Europe have also indicated the significant importance of animal products in the diets, and similar evidence of the consumption of animal meat is also found in the later Mesolithic periods in Europe

There is a significant change in the archaeological record associated with the introduction of plant domestication (i.e. the Neolithic period in Europe and the Near East), such as the appearance of pottery, stone tools for plant processing, and the remains of the domesticated plants themselves (68) . There is, in many areas, an associated general decrease in body stature, dentition size, and an increase in caries rates. The smaller dentition is not due to more meat, but instead to the consumption of easier to chew processed foods like bread and porridges, and the carbohydrate contents of those foods result in the increased caries rates. There is also a range of diseases associated with the consumption of these processed foods and related to the sedentism and urbanization that often follow from the increased reliance on domesticated plants (69).

However, associated with the general decrease in health associated with the adoption of agriculture, as evidenced in skeletal remains, is a significant and dramatic population increase, which is the trade-off that our ancestors made. To increase population size food production must increase beyond the carrying capacity of the environment, and domestication and control of plants and animals allow this. However, associated with this is overcrowding and the observed general decline in individual health, and we are still living with the effects of this Neolithic revolution today.

Archaeologists and palaeoanthropologists have uncovered a picture far more complex than the popular media presentation, but the guiding principle is highly likely to be true - that we can learn from the deep past. The main thing that archaeology and evoutionary science can offer on the matter of diet is knowledge - an outline sequence of events, a timescale, and in particular knowledge emphasizing that the past was highly varied, and that human ancestors made a multiplicity of adaptations through millions of years. This is not to say that ‘the Stone Age’ is the term that an archaeologist would begin with. Archaeology distinguishes between the Paleolithic or Old Stone Age, associated with human origins and economies of hunting and gathering; and the Neolithic (never now termed the New Stone Age), which is defined by the economies of domestication and agriculture (perhaps where things began to go wrong in dietary terms!).



"Something's just not right—our air is clean, our water is pure, we all get plenty of exercise, everything we eat is organic and free-range, and yet nobody lives past thirty."

VIII.3. Focus on Subsistence



This chapter is specifically concerned with the subsistence economy of Paleolithic existence, in which hunting-gatheringscavenging played an exclusive subsistence role. It is, in effect, an extension of

the last chapter that chronicled the dietary changes through the Stone Age. We discuss here some aspects of this subject in generalities and fill the gaps that remained in the full understanding of the ways hunter-gatherers lived. We also touch upon a few topics that are of some theoretical importance. Our focus is mainly on the foragers of late Pleistocene and early Holocene, a time period that is generally discussed in terms of the Epi-Paleolithic period or the Mesolithic Transition.

Subsistence, to an archaeologist anyway, refers to the suite of behaviors that humans use to feed themselves, whether it be hunting animals, fishing, or gathering plants, fruit, and nuts. The landmarks of subsistence include the control of fire, sometime in the Middle Paleolithic (50,000-300,000 years ago), the hunting of game with stone projectiles, food storage, and what Flannery calls the "broad spectrum economy" by the Upper Paleolithic (ca 40,000-10,000 years ago). After that, agriculture was invented in different places at different times between 10,000-5,000 years ago. Scientists study these prehistoric subsistence regimes by observing a wide range of artifacts and measurements, including faunal remains, and food processing tools.

Hominins have subsisted from some combination of plants and animals for more than 2.5 million years. However, the nature of hominin diets, including the ways foods were obtained, the package sizes normally acquired, and the manner in which nutrients were extracted and processed, has changed dramatically over this time span. Several shifts in the human predatory niche are reflected by ungulate archaeofaunal remains in particular. These include a probable transition sometime in the Plio/ Pleistocene from hunting smaller prey and scavenging larger ones to an increasing emphasis on larger animal hunting, from tool-assisted extraction of consolidated bone marrow to full-scale butchering, processing, and storage of animal tissue, and, lately, from large-game hunting to animal husbandry. In this regard, the most of the accounts are Eurocentric. It is therefore not surprising that most discussions of humans as predators focus on large game.

Early humans most likely lived in mixed habitats which allowed them to collect eggs, nuts, fruits and grass seeds. Rather than killing large animals themselves for meat, they probably used carcasses of large animals killed by other predators or carcasses from animals that died by natural causes. Hunting, along with gathering, was presumably the subsistence strategy employed by humans beginning quite later. Food gathering was largely replaced by food producing by ca. 10,000 years ago and today most of the world population depends on produced food rather than collected or gathered food. Even the remaining hunter-gatherers depend to some extent upon domesticated food sources either produced part-time or traded for products acquired in the wild. Conversely, some isolated agriculturalist groups also regularly hunt and gather for their subsistence. Yet thousands of people

today in India and parts of Africa do remember their hunter-gatherer past. Millions live in cultures with a collective memory of their huntergatherer ancestors, and millions more probably believe in the hunting-gathering-foraging condition of the human past as a self-evident truth and, in a sense, more ‘natural’ or even more ‘human’ than that of the people who live in agrarian societies.

It is difficult to determine what groups of people ate yesterday, let alone thousands of years ago (21) especially when they left no written records. To estimate ancient diets, we must rely on archaeological analyses of the diets of hominoid primates and early hominids, and observations of indigenous populations who still hunt and gather for subsistence. Interpreting such evidence requires careful consideration of underlying assumptions that are not easily tested. Although hunting-gathering was the common human mode throughout the Paleolithic, the current-day hunters and gatherers does not necessarily reflect Paleolithic societies; the huntergatherer cultures examined today have had much contact with modern civilization and do not represent "pristine" conditions found in uncontacted peoples.

The transition from hunting and gathering to agriculture is not necessarily a one way process. It has been argued that hunting and gathering represents an adaptive strategy which may still be exploited, if necessary, when environmental change of subsistence observation of causes extreme food stress for agriculturalists. In fact, it is sometimes difficult to draw a clear line between agricultural and hunter-gatherer societies, especially since the widespread adoption of agriculture and resulting cultural diffusion that has occurred in the last 10,000 years.

The Foraging Way versus Settled Life: For Gordon Childe, the primary characteristic of prehistoric foragers was their necessity to stay mobile in the pursuit of their food. This drastically curtailed their ability to multiply, and also the amount of leisure that they had. They did not generally store food or build substantial houses; they could own little, because everything had to be carried with them when they moved. On the other hand, their flint and bone toots were extreme\y sophisticated, and there are many indications that these societies could have a rich spiritual life and well-developed aesthetic feelings. They must also have had a profound understanding of the natural world they inhabited, of the habits of the game they hunted, of the uses of different plants for food, dyes, potions, and so on. Hunting large game must surely have involved the cooperation of a group larger than the natural family. Presumably these bands were self- contained, and self-sufficient. On the analogy with recent foraging societies, he suggested, hunting and fishing territories were probably communally owned, with men involved mainly in hunting and women in gathering, and the resulting food shared within the community. Presumably these societies were fundamentally egalitarian. Childe also noted that in recent foraging societies particular individuals such as older males might enjoy authority and prestige, and that a few societies such as those of coastal North-West America, where rich fish supplies sustained sedentary villages, had complex social structures characterized by hereditary chiefs, wealth differences, and warfare. However, they were the exception, not the rule.

Early farming societies, in contrast, had 'a new aggressive attitude to the environment' (Childe). This was evidenced most of all in their systems of plant and animal husbandry, but was also inherent in other characteristics of these societies: in the firing of clay to make pottery; the spinning of plant and animal fibers to make cloth; the selection of different types of stones for making quern-stones, sickles, polished axes and adzes; and the use of materials such as mud, reeds, timber, and stone to make houses. There was probably a clear division of labour between the sexes, men herding and hunting and women cultivating as well as undertaking tasks such as potting and weaving. People lived

in settled villages, though they moved on every few years in search of new land if and when agricultural yields fell. They were able to plan ahead, storing food in granaries. The basic social unit was the household, villages consisting of clusters of households. Though the entire village community might cooperate for certain major tasks, each household probably aimed to be more or less self-sufficient in terms of growing its own food and obtaining the local resources it needed of stone, bone, wood, and clay. In practice, though, this was not possible, so a normal feature of early farming societies was trade; the evidence mainly consisted of luxury goods that survive in the archaeological record, but exchange in perishable everyday items was probably also important.

Childe's understanding of the differences between typical foraging and agricultural societies was remarkably similar to the classifications developed later by American anthropologists that, though regarded as overly simplistic and neo-evolutionary today, still provide an important framework of reference (55). Hunter-gatherers were classified in these schemes as *band* societies, classically defined as mobile, territorial, egalitarian, and fluid in band membership. Small-scale agriculturalist societies were characterized as *tribal:* usually sedentary, organized as extended families in separate kin groups, with loosely developed vertical differentiation (that is, differences according to social status), and with most production organized at the household level- what Sahlins called the Domestic Mode of Production. More complex ergricultural societies with greater social and economic differentiation (with systems of redistribution, and exchange of prestige goods, for example) were characterized as *chiefdoms.*

The extent to which foragers hunt, fish, and/ or gather depends first of all on the latitude at which they live. As a general rule, productivity in terrestrial ecosystems decreases with distance from the equator, along with the length of the growing season. A food-rich environment like rainforest has high plant productivity and a rich diversity of habitats from the forest floor to the upper canopy. An arctic tundra or a desert, by contrast, has low plant productivity and few animal species. Decreasing productivity in vegetation means fewer plants for human consumption, so foragers living further from the equator need to rely more on animals to convert the available plants to energy. Marine resources also differ markedly with ocean productivity. Generally, therefore, tropical and desert foragers rely heavily on plant gathering, foragers in temperate latitudes rely more on hunting and fishing than gathering, and at extreme latitudes only hunting and fishing may be possible. The absence of large assemblages of animal bones at the Mesolithic settlements in Sindh can probably be explained in this context. At the regional scale, of course, there is rarely a simple predictive relationship between latitude, productivity, and subsistence strategy. For example, hunting will be particularly productive when there are aggregations or herds rather than small dispersed populations of animals: large clusters of big animals on a tundra or savannah are clearly more of a hunting proposition than, say, lots of small animals in ones or twos in a thick forest. An ocean may be rich in mammals and fish, but people have to have a fishing technology capable of catching them. The absence of any fishbones in the coastal settlements in Makran, in contrast to such finds in other areas of the world, probably be explained on such regionspecific causes.

An important distinction in mobility patterns was pointed out by Binford (56), between what he termed *foraging* and *collecting* systems. Foragers use a series of residential or base camps located to have daily access to favored food sources. People go out from the campsite on a daily basis as individuals or in groups to hunt or gather, the whole group moving from one camp to the next as the resources around the former start to diminish. Foragers of this kind are typical of plant-rich environments, such as the !Kung-San of the Kalahari. Collectors are typical of extreme-latitude

environments subject to dramatic fluctuations in the abundance of



food resources in time and space. They have residential or base camps for the main population, but hunting parties set up a variety of field camps, observation stations, and intercept hunting camps at a distance to monitor game movements, hunt and kill the game. They cache the meat around the landscape and bring food back to the main camp as and when required. An example of these was the Nunamiut reindeer-hunters of Alaska. Careful planning is required by collectors to solve their formidable logistical problems. They generally need to use more complex technologies for acquiring their food than foragers in richer environments. Another common trait amongst them is the frequency of food processing (such as drying) and storage systems to cope with the fact that resources are not only scarce but also only available in certain seasons .

What is the archaeological evidence for pre-agricultural diets and how have they changed over the four million years of hominid evolution? The last chapter briefly introduced three lines of evidence we have for Paleolithic and Neolithic diets; morphological evidence, and bone chemistry. The morphological changes, increasing gracilization of the mandible and increasing brain size have been interpreted (based on changes, archaeological material direct measurement of diet from analogies with living primates) as the move from plants to higher-quality, more digestible, animal meat, although this is debated. The archaeological evidence is especially weak, as many organic materials, especially plants, do not survive well, and are therefore invisible in the archaeological record. Artifacts, such as stone tools which are likely to be used for hunting and animal bones with evidence of human processing and butchering do indicate that hunting did occur in the past, but scavenging was perhaps more frequent. Direct evidence from bone chemistry, such as the measurement of the stable isotopes of carbon and nitrogen, do provide direct evidence of past diet, and limited studies on five

Neanderthals from three sites, as well as a number of modern Paleolithic and Mesolithic humans indicates the importance of animal protein in diets. There is a significant change in the archaeological record associated with the introduction of agriculture worldwide, and an associated general decline in health in some areas. There is a rapid increase in population associated with domestication of plants, so although in some regions individual health suffers after the Neolithic revolution, as a species humans have greatly expanded their population worldwide.

Optimal Foraging Theory: Over the past twenty years, many anthropologists and archaeologists have attempted to understand forager subsistence, present and past, in terms of a body of theory derived ultimately from behavioral ecology and evolutionary biology. The result is the Optimal Foraging Theory. The basis of this theory is the as



sumption that the economic actions of foragers will be sensible and effective in context, seeking to maximize rates of energy return and to minimize risk. Foragers are faced with a range of opportunities and constraints on a daily basis. Different resources provide different amounts of energy, but their acquisition also takes energy, and foraging time is finite. They therefore have to weigh up competing demands relating especially to the density and distribution of resource 'patches' (whether patches of vegetation, or groups of animals, or individual animals) and the time it will take to locate, pursue (if an animal), and process a resource and, if desired, get it back to camp.

The foraging opportunities in a 'fine-grained' landscape with a homogeneous distribution of resource patches will clearly be very different from those in a 'coarse-grained' or heterogeneous landscape with diverse patch distribution and composition. A typical choice might be whether to collect seeds that were perhaps abundant but yielding little energy for the time and effort expended, or to concentrate on hunting game, an activity requiring greater effort and with more risk of failure, but with potentially more attractive rewards. Collecting the seeds might be worthwhile if they are near to camp, because whole bushes can be brought back for processing at leisure, but not when it takes a long time to travel to them, collect them, and then strip the seeds from the plants for efficient transport back to camp.

Alongside questions of relative efficiency, foragers also have to take into account the relative risks in pursuing particular foods. Risks can be mitigated by a variety of behaviors including storing and/or

sharing food, coming together and splitting up from season to season, working together in collaborative hunts, using technologies effectively, and sharing information within and between groups so that resource patches can be located faster, or sampled more quickly, or not abandoned too soon.

The assumptions underpinning optimal foraging theory, of maximizing efficiency and minimizing risk, have been investigated in detailed studies of the subsistence strategies of modern foraging groups in very different environments, including the rainforests of Paraguay, Ecuador, and Venezuela in South America, the rainforests of the Congo, the desert interior and tropical coastal islands of Australia, and the northern forests of Canada (3). In these studies, resources were ranked in terms of their potential net energetic return, and the actual behavior of the foragers then compared with the 'ideal' subsistence strategies suggested by optimal foraging theory. In general, the actual behavior of the foragers closely fitted the predictions of the foraging model proposed for them (3).

Optimal foraging modeling has been criticized as being overly deterministic and ignoring the complexity of foragers' 'world-views'. However, its importance is not that it tries to predict in a formulaic or environmentally deterministic manner what past foragers in a particular region at a particular time *will* or *must* have done. Rather, it allows archaeologists to compare their data (sites in particular locations, and particular assemblages of tools and food remains) with an independently established foraging model and then reflect on the similarities or divergences that emerge from the comparison. However, one must keep in mind that relying over-heavily on modern or recent ethnographies to explain archaeological data carries its own dangers of imposing the present on the past.

Carrying Capacity: The carrying capacity of a biological species in an environment is the maximum population size of the species that the environment can sustain indefinitely, given the food, habitat, water and other necessities available in the environment. In population biology, carrying capacity is defined as the environment's maximal load. It is different from the concept of population equilibrium. Carrying capacity, at its most basic level, is about organisms and food supply, where "X" amount of humans need "Y" amount of food to survive. If the humans neither gain or lose weight in the long run, the calculation is fairly accurate. If the quantity of food is invariably equal to the "Y" amount, carrying capacity has been reached. Humans, with the need to enhance their reproductive success , understand that food supply can vary and also that other factors in the environment can alter humans' need for food.

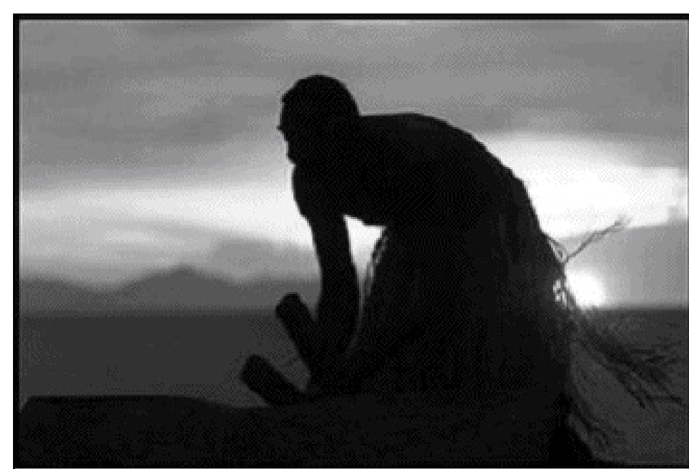
The idea that carrying capacity represents a static ceiling around which human populations maintain an equilibrium has been outmoded for some time. It has begun to be replaced with more dynamic view of the relationship between population density, prey density, individual energetic efficiency and reproduction rates. Second, the fertility rates of traditional populations across all subsistence modes vary considerably around the same mode and nearly the same mean; the continued search for ways in which the specific circumstances of subsistence strategies tweak the proximate determinants of fertility does not seem a very profitable avenue of investigation for explaining broad changes in growth rates in human history. Rather, a closer look at the ways in which individual energetic efficiency, resource depletion rates and resource structure vary generally across subsistence modes and affect population growth rates and densities appears to be in order.

Finally, the idea that infrequent, but serious population crashes have played a substantial role in

shaping past human population trajectories deserves a closer look. Population crashes are rare events viewed from the perspective of the human lifespan – if they were not, there would be no one alive today to muse on the human condition. The fact that they are so infrequent appears to have led to the perception that they are abnormal or atypical events. There is a growing theoretical and empirical basis for believing that population crashes are not atypical, and that they may provide the most parsimonious explanation of near-zero growth rates through much of subsistence strategies and early human population history (70).

Technology is an important factor in the dynamics of carrying capacity. For example, the Neolithic revolution increased the carrying capacity of the world relative to humans through the invention of agriculture. Currently, the use of fossil fuels has artificially increased the carrying capacity of the world by the use of stored sunlight, albeit at many other expenses. Carrying capacity has been variously related to demography in the past and the echos of these proclamations are heard even in the present time.

Broad Spectrum Diet and its Implications: Broad Spectrum Diet is another topic that has aroused a great interest among anthropologists dealing with the subsistence regimes of huntergatherers in prehistoric times. In simple terms, dramatic and rapid climate-induced fluctuations in the abundance and distribution of food resources during late Pleistocene/early Holocene period forced foraging peoples to adopt new foodstuffs (including small mammals, aquatic resources and small-seeded plant foods) that were abundant but entailed high procurement and processing costs. This broadened the spectrum of food consumed by foragers and it appears that such a diversification in food consumption occurred worldwide (13).



Binford (57) and Flannery (13) first recognized links between culture change and expanding diets of Late Pleistocene foragers in Eurasia in the late 1960s. Binford described substantial diversification of human diets in middle and high latitude Europe at the end of the Paleolithic, or Mesolithic, roughly 12,000–8,000 years ago. Rapid diversification in hunting, food processing, and food storage equipment generally accompanied the dietary shifts, which he took to be symptoms of intensified use of habitats and fuller exploitation of the potential foodstuffs they contained. Some of this behavior was directed to grinding, drying, and storing nuts, but it also involved hunting of small animals. Flannery pushed these observations further in 1969 with his “Broad Spectrum Revolution” hypothesis, proposing that the emergence of the Neolithic in western Asia was prefaced by local increases in dietary breadth in foraging societies of the late Epi-paleolithic. He argued that subsistence diversification, mainly through adding new species to the diet, raised the carrying capacity of an environment increasingly constrained by climate instability at the end of the

Pleistocene.

Both authors suggested that local imbalances in human population density relative to available food were somehow integral to the remarkable changes that took place in human societies just prior to the Paleolithic–Neolithic, or forager–farmer, transition from 10,000 years ago onward. They also argued that economic change could have resulted from demographic crowding in certain regions of the world, which may also have altered the conditions of natural selection on human societies. Binford's and Flannery's papers have stimulated much archaeological research and many debates over the last three decades, not least because they offer some explicit predictions for subsistence change. It is of historical interest that these anthropological arguments were influenced by early works in the science of population ecology, including what later came to be known as foraging theory and diet breadth models.

Plant foods that are relatively timeconsuming to collect and process, such as acorns or other seeds, are ignored by some foragers, and routinely collected, processed and consumed by others. What kinds of factors affect how humans choose which food items to pursue, process and consume? The diet breadth or broad spectrum foraging model was employed to answer this kind of question. The logic of the model begins with the observation that different kinds of potential food items in the environment vary in the amount of time it takes to locate, capture or collect them, and to process or render them into a form available for consumption and digestion. Which ones should a forager expend time and energy capturing or collecting when they encounter them, and which ones should they ignore in favor of continuing the search for energetically valuable prey or plant food? To answer this essentially economic problem, the model makes several simplifying assumptions. First, foragers encounter potential food items in the environment at random. Second, foraging costs are measured in terms of time, and total foraging time is partitioned into two mutually exclusive categories: search time, or time spent locating prey items or plant food in the environment, and handling time – time spent pursuing, capturing/collecting, processing and consuming the food once it is encountered. Third, foragers rank their preference in potential food in terms of profitability, defined as the net energy return rate obtained per unit of time expended in handling time upon encounter. The question then boils down to this: as a forager is searching through the environment and encounters a potential food item, should he or she pursue it and eat it, or should he or she ignore it and continue to search for something more profitable? The answer is: foragers should take lower-ranked prey only as long as the return rate per encounter is greater than the average return rate gained from searching for and handling higher-ranked prey or other food source.

One widely recognized implication of this is that high-ranked prey should be taken when encountered, no matter how rare they become, and that prey ranked below the optimal diet breadth will not be taken no matter how abundant they are. This means that, given any population growth at all, depletion of foraged resources is nearly inevitable, and that depletion should begin with the highestranked resources. How low on a ranked list of potential prey a forager will be willing to go depends upon the encounter rates of higher-ranked prey. Thus, as higher-ranked resources are depleted, lower-ranked items are added to the diet. Lowerranked prey are ranked lower because they entail higher handling costs per encounter. Hence, handling costs add up as diet breadth widens and broadening the diet breadth in the face of depletion of higher-ranked foods due to harvest pressure entails a decreased individual energetic effciency. Hence, we can say that there has been a general historical trend toward lower individual energetic efficiency (i.e. decreased net return rate) in human subsistence strategies, with a corresponding increase in spatial efficiency, defined as increased

average total productivity per unit area of land. Very broadly speaking, the adoption and cultivation of domesticates can be seen at least in part as the culmination of this historical trend at the end of the Pleistocene.

A second broad implication of the diet breadth model is that the traditional concept of carrying capacity as a definable limit or ceiling on growing population is far too simplistic. First of all, the model implies that, at any given time, there is likely to be a whole array of food items in the environment that may in fact be quite abundant, yet are not exploited because they are uneconomical to process. Second, it is clear that the relationship between population size and prey abundance is dynamic: as populations grow larger, prey abundance responds logistically – as prey abundance declines, efficiency also declines and population growth is slowed. Finally, we can see that the commonly accepted definition of carrying capacity as the upper limit of human population growth that can be achieved in a given habitat without eventual degradation of the resource base is unrealistic: depletion is always occurring, and has an ongoing, dynamic relationship with forager population size.

Evidence of increasing dietary breadth is expected to take the form of more species in the diet and/or greater proportional evenness among high-ranked and low-ranked prey items in response to declining availability of preferred types. A predator can afford to ignore lower quality prey at little cost if the chance of finding a superior type in the near future is high. These kinds of foraging conditions foster narrower diets that emphasize just a few favored types disproportionately to their availability in the environment. As the supply of preferred prey dwindles, however, broadening the diet to include common but lower yield prey types maximizes a predator's returns per unit expenditure by reducing search time . This second set of conditions therefore encourages more diverse diets in the sense that the predator's emphasis is spread more evenly among the number of prey types that occur in the environment.

Broadening of Paleolithic diets in Eurasia certainly is apparent from greater exploitation of energy-rich nuts and large seeds with time. Because the nutritional benefits of these resources require considerable work and equipment to extract, the trend is most readily apparent from the proliferation of milling tools after the Last Glacial Maximum and to a lesser extent from increasing evidence of storage facilities and preserved plant parts. Under lean conditions people should also have become less selective about what animals to hunt rather than go hungry. Yet, the story from the faunal evidence is much less clear than that for plant use.

Importance of Meat in Paleolithic Diet: Anthropologists draw dietary inferences from examinations of fossilized bones and teeth, shell mounds, artifacts used for food acquisition and preparation, and the topography of archaeological sites, as well as from chemical analyses of bones, teeth, and plant remains. The gold standards for dietary intake, however, are faecal food remains and stomach contents; such samples are rare but constitute the only unequivocal proof of actual ingestion (72). Together, such studies provide considerable evidence for meat consumption by early humans. Fossil animal bones at archaeological sites display cut and hammer marks, teeth marks, and breaks that are consistent with meat consumption, and stone artifacts found at such sites also are consistent with meat-eating. Certain pathological changes in fossil human skeletons appear similar to those found in the skeletons of people who suffer from vitamin A toxicity, a condition that could only have occurred if early humans ate animal liver.

Eaton & Konner (19) estimated the proportion of plant foods in the diets of hunter-gatherer groups as 50–80% by weight in inland, semitropical habitats, 50–90% in coastal areas, but less than 10% in the northernmost Arctic. Despite recent suggestions that animal foods comprised 45–65% of energy intake the preponderance of evidence supports the idea that plant foods predominated in the diets of hunter-gatherer groups living in areas where plants could be grown (20).

In 1985, the American anthropologists Eaton and Konner (19) reviewed the evidence related to the diets of our Paleolithic ancestors by evaluating the nutrient content of 69 game and plant foods they were likely to have eaten. Eaton and Konner made the intriguing suggestion that prehistoric diets must have contained far more protein – and therefore far more meat than is currently consumed or recommended. In 1997, they expanded their food survey to include 321 plants and animals (71). Their more recent suggestion is that the Paleolithic diet must have included 37% of energy from protein, 41% from carbohydrate, and 22% from fat, along with amounts of vitamins, minerals, and fibre that seem unimaginably high and unachievable through modern-day diets.

On the other hand, studies of the San and !Kung peoples of the Kalahari showed that they relied heavily on gathering, a practice that did not take much time or effort in an environment of abundant plant resources. The groups consumed more than 150 plant and 100 animal species, but derived most of their energy from just 23 plant species. These plants provided a dependable food source, whereas game was scare, difficult to find, and hard to kill; snakes, lizards, and insects were not eaten. Thus, about 80% of the diet by weight consisted of foods from plant sources (16).



Slow moving, briskly breeding small animals, such as tortoise and hare, were a primary source of protein in resource-deficient environment, such as deserts and semidry areas.

European Paleolithic subsistence is assumed to have been largely based on animal protein and fat, whereas evidence for plant consumption is rare. Recent evidence has, however, shown that vegetal food processing, and possibly the production of flour, was a common practice, widespread across Europe from at least ~30,000 years ago. It is likely that high energy content plant foods were

available and were used as components of the food economy of these mobile hunter–gatherers (73).

Findings of ancient human and animal bones occur only rarely, and such sites are scattered, poorly preserved, and incompletely recovered. All such samples are necessarily biased. Because bones are better preserved than vegetable matter, they give the impression that hunted animals must have been the primary food sources. Thus, archaeological techniques tend to underestimate plant consumption and overestimate animal consumption. Moreover, finding animal bones or fossilized seeds at a site does not prove that they were used as food. For these reasons, experts continue to argue that early humans ate little but meat, while others view the archaeological evidence simply as consistent with meat-eating although too ambiguous to draw dietary inferences. Whatever the proportion of plant to animal foods, the life expectancy of Paleolithic humans has been estimated as about 25 years (61), suggesting that the diet, along with other conditions of life, must have been less than ideal. Even this point is debated, however, as foraging for tubers and other plants by 'grandmothers' could well have promoted infant survival and adult longevity equivalent to levels seen today (46).

The one exception occurs among the indigenous people of Arctic North America, the extreme of human (and plant) habitation. In the 1920s, Arctic Inuit were reported to rely completely on hunting for their food, but to do little or no gathering, particularly at latitudes above 49 degrees (16). Instead, the population depended on marine and land mammals and fish for 80–100% of intake and therefore on a diet based almost entirely on animal protein and animal fat (17).

The consumption of meat, and later fish, by early humans as a major source of energy in cold climates is not disputed. This peculiar adaptation most likely comes from the compulsion that plant growth is slow and seasonally short-lived in cold climates while animal foragers are in abundance. In the tropicals, however, the situation is reverse. Here, there is no such compulsion and humans were more likely to depend more on plant food, including nuts, fruits, tubers, etc, than on meat. The evidence on this subject is not clear. The data are



Flesh of small animals was an important component of Paleolithic diet

zooarchaeological but, as indicated above, it should be understood that the general phenomena we are dealing with must also have included changes in how humans made use of plants. Bones preserve better and thus the possibilities for investigating the changes in diet from a zooarchaeological perspective are relatively rich and geographically widespread.

The Issue of Grass Seeds as a Staple Food for the Paleolithic People: Since the 1960s, grasses

(particularly the wild progenitors of cereals) have been identified as the abundant wild food resource that enabled widespread sedentism in the Epi-paleolithic of Southwest Asia. Although archaeological evidence for Epi-paleolithic diet has, until recently, been scanty, the important (if not the dominant) role of domesticated cereals in early farming sites has often led to the assumption that their wild progenitors had the same importance to hunter-gatherers. Grasses are indeed an important component of several Epi-paleolithic/early Neolithic archaeobotanical assemblages and are useful to archaeobotanists because they can, unlike legumes, show clear evidence of domestication. As a result, a substantial body of research has focussed on wild grasses. However, the importance of grasses has slipped into the theoretical domain and may have unduly influenced concepts and vocabulary. For example, the practice of referring to the wild progenitors of cereals as 'wild cereals'. The focus on wild grasses in pre-agrarian subsistence can be traced back to the 1950s excavations at Eynan-Mallaha. The presence of storage pits at Natufian Eynan and the apparent concentration of Natufian sites in areas with dense stands of grasses (including the wild progenitors of cereals) led to the Natufian being considered 'not only as the first sedentary communities in the Levant, but as ''harvesters of cereals'' (76). However, Cauvin also writes: 'we concluded too rapidly, in the absence of any botanical studies, that they [the Natufians] were specialized gatherers of cereals who were somehow preparing, through this choice, the future cultivation of these plants' (77). Nonetheless, the role of 'wild cereals' remained deeply rooted in the theoretical domain. For instance, Henry (78) states that the most important change in subsistence strategies during the Natufian was the intense harvesting of 'wild cereals' and nuts, which both allowed and demanded sedentism. Other work incorporates a similar approach: see, for example, Flannery (13,), McCorriston and Hole (79), Bar-Yosef and Meadow (80) and Smith (81).

In a review paper, Savard et al (82) extensively examined the role of grasses in sedentary hunter-gatherer subsistence strategies, along with its implications for theoretical models of sedentism and the origins of agriculture. New evidence from four broadly contemporary sites from the northern Fertile Crescent was presented and compared to archaeobotanical results from other Epi-palaeolithic, Natufian or early Neolithic sites that display some evidence for sedentism, most of them from the Levantine and the Euphrates corridors.

Barley (*Hordeum vulgare L.*) and wheat (*Triticum monococcum L. and Triticum turgidum L.*) were among the principal 'founder crops' of southwest Asian agriculture. Two issues that were central to the cultural transition from foraging to food pro- duction are poorly understood. They are the dates at which human groups began to routinely exploit wild varieties of wheat and barley, and when foragers first utilized technologies to pound and grind the hard, fibrous seeds of these and other plants to turn them into easily digestible foodstuffs.

Piperno et al (74) report the earliest direct evidence for human processing of grass seeds, including barley and possibly wheat, in the form of starch grains recovered from a ground stone artifact from the Upper Palaeolithic site of Ohalo II in Israel. Associated evidence for an oven-like hearth was also found at this site, suggesting that dough made from grain flour was baked. Their data indicate that routine processing of a selected group of wild cereals, combined with effective methods of cooking ground seeds, were practiced at least 12,000 years before their domestication in southwest Asia.

European Paleolithic subsistence is assumed to have been largely based on animal protein and fat, whereas evidence for plant consumption is rare (75). Revedina et al presented evidence of starch grains from various wild plants on the surfaces of grinding tools at the sites of Bilancino II (Italy),

Kostenki Uglyanka (Russia), and Pavlov (Czech Republic). The samples originate from a variety of geographical and environmental contexts, ranging from northeastern Europe to the central Mediterranean, and dated to the Mid-Upper Paleo- lithic. The three sites suggest that vegetal food processing, and possibly the production of flour, was a common practice, widespread across Europe from at least ~30,000 years ago. It is likely that high energy content plant foods were available and were used as components of the food economy of these mobile hunter–gatherers.

The Neanderthal's Diet: Neanderthals are the second most studied hominin species after our own and yet many of the ecological and behavioral facets of this species are not well understood. Perhaps a major historical stumbling block has been an overemphasis on gauging the physiological and bebavioral aspects of this species against those of the Upper Paleolithic anatomically modern humans which eventually replaced it. Much emphasis has also been placed on debunking the traditional view of Neanderthals as a brutish, maladaptive species which failed to compete with the anatomically modern humans over the same habitats. We now know that Neanderthals successfully adapted to the fluctuating climatic conditions of the last glacial and at some stage of their existence have managed to extend their geographic distribution as far east as the Altai Mountains.

Our perception of Neanderthal hunting abilities has drastically altered during the past decade as a consequence of archaeozoological studies of Middle Paleolithic assemblages. These studies indicate that Neanderthal subsistence varied by period and region with evidence of big game bunting, often with a clear focus on prime age adults of a narrow number of ungulate species, and the adoption of a broad spectrum subsistence range which includes frequent hunting and possibly trapping of small game. Additionally, stable isotope studies confirm that meat played a major role in Neanderthal diet, as expected in the case of a species which occupied the high-latitude and highaltitude regions of Eurasia.

Conclusion: What are we to make of this proposition? Throughout the course of human history, societies have developed widely varying dietary patterns that take advantage of food plants and animals available as a result of geography, climate, trade, or economic status (84). Our very existence indicates that ancestral diets must have provided sufficient energy and nutrients to support growth and reproduction. Whether they optimally promoted adult health is more difficult to determine but seems unlikely, given the sharp increase in human life expectancy observed during this century. Also at issue is the precise composition of prehistoric diets, their relative proportion of animal and plant foods, and the quality and credibility of the evidence in support of their evolutionary derivation.

As should be apparent from this brief overview, the evidence for the relative proportions of animal and plant foods in the diets of early humans is circumstantial, incomplete, and debatable. The available data are insufficient to identify the composition of a genetically determined optimal diet, if


Foxtail barley grass

such exists, let alone draw compelling inferences. Despite our current consumption of non-Paleolithic diets, the lifespans of adults in most industrialized countries are lengthening, and populations are remaining relatively healthy into ripe old age. The evidence related to Paleolithic diets can best be interpreted as supporting the idea that diets based largely on plant foods promote health and longevity, at least under conditions of food abundance. Substantial and compelling evidence supports recommendations that people in industrialized and industrialising economies could reduce risks for chronic disease if they increased their intake of fruits, vegetables, and grains in proportion to animal foods, and kept as active as our hunter-gatherer ancestors.

VIII.4. Desert People



Pakistan is essentially a desert country - an integral part of the vast dry span that extends from the Sahara to the Thar Desert in the east and extending to the Taklamakan and Gobi Deserts in the north, enveloping most of the Middle East, Iran, Afghanistan, Turkistan, and western China. Parts of this desert are sandy plains, such as those between the Indus and the Hakra river systems, and some are hilly areas, such as those of Baluchistan, but dry nonetheless. It is only in the north of Pakistan where the rainfall is enough as to spare it of this characterization. Pakistan is, however, not the Sahara: the rainfall is meager but it is enough to support some wild life. It is also not Iranian deserts where fertile valleys are only few and far between. Pakistan is more like Egypt and Iraq whose ancient dwellers have had plenty of river waters that sustained them quite adequately. The Indus plains are, however, unique in this respect: its river system, the Indus and its numerous tributaries, is the largest in the world. Despite these differences, the Paleolithic life would have been no different here than in other parts of the world, some of which are inherently drylands, deserts, or semi-deserts. It is because of this connection that we are interested in the huntergatherers of Africa, Australia, and the Middle East where research has been much more extensive than that in Pakistan, India or Iran.

For centuries desert have captured the public imagination as places of extremes. These are landscapes that might be perceived as impenetrable barriers to human occupation. They are of course also the same terrain through which the Tigris and Euphrates Rivers pass and whose vast spans the Indus and the Niles traverse. These rivers when hydraulically ‘tamed’ became the agricultural powerhouses of the world.

Desert societies have also been central to anthropological imagination and several studies of this nature have been conducted in the last two or three decades in the deserts of Australia, Kalahari, and the Sahara. Earlier studies have concentrated on the Levant and western Iran. Surprisingly, very few analyses have adopted a comparative perspective on a global scale beyond a paper by Peterson wherein he compared the people of the Kalahari and those of Australia (85). *Desert Peoples: Archaeological Perspectives* edited by Peter Veth and his associates is probably the only book-length

selection of studies that provides us with a broader canvass for our view. Surprisingly also, no anthropological investigation has ever been undertaken in Pakistan or in the neighboring areas of the Great Desert, i.e. The Thar, in India or Pakistan. Only one study comes to mind and that is by Bridget Allchin and her associates in 1974-75 (86) but it is generally confined to their own archaeological work. A smallish book by Sharma also appeared in 1989 (87) but it is touristic in nature. A well-illustrated book on Cholistan was published sometime ago by Mughal (88) and it is indeed of some value for matters prehistoric.

This chapter aims to bring together the various studies in diverse desert regions and, as a corpus, apply the conclusions to the dry zone of Pakistan, which is probably more than 75 percent of its total area. This is a comparative approach to the emergence and diversity of global societies and an attempt to gain a view, as limited as it obviously is, of the peoples of Sindh, Baluchistan, and southern Punjab, as well as those of the dry hills of the Pashtun country and Pothwar.

Generalized Foragers: Over the last century, hunter-gatherers studies have moved from a social evolutionary perspective at the close of the nineteenth century to structural-functionalist or cultural ecology frameworks in the twentieth century. The *Man the Hunter* symposium (89) in 1968 promulgated a now popular model of hunter-gatherers society, the “generalized forager” model, which was based substantially on these desert hunter-gatherer groups. Under this model, generalized foragers shared five basic characteristics: egalitarian society; low population density; lack of territoriality; minimal food storage; and fluid band composition with changes in residential mobility used to maintain social ties and reduce intergroup conflict though it remains to be determined whether these are characteristic of foragers in desert environments, rather than hunter-gatherers in general (90).

The elements of this socio-economic model had been formulated in Steward’s (91) pioneering eth,Hiscockstudy of Great Basin *Shoshone* and *Paiute* foragers. This model was reinvigorated during the at sometimes, corridors at others (92). Studies of desert societies have also provided some of the most fertile ground for debates about human adaptability and how societies cope with marginal – often precarious – environmental circumstances, and about the dispersal (93).

1970s, and at that time !Kung bushmen came to be Global Deserts in Perspective How do societies in marginal environments seen as the quintessential hunter-gatherers. A reactually deal with risk in either a reactive or strateview of social and behavioral variability in hunter
gatherers shows that there is a wide spectrum of
hunter-gatherer societies if groups living in other
types of habitats are included in the analysis . Over
the last 20 years, hunter-gatherer research has
shifted towards either behavioral ecology or histori
cal analyses of these societies. [For accessible in
terdisciplinary overviews of hunter-gatherer studies,

NORTH see Lee and Daly (1) or Panter-Brick et al. (2)]
gic sense? Many desert foragers in the ethnographic record appear to have responded by changing their diet-breadth and residential mobility. For

others, such as in the western Sindh, the proximity ASIA

of deserts to the major zones of plant and animal domestication appears to have provided a mutual ecology of change, in both the mode and relations of production. The long-term dynamics of both de

AMERICA EUROPE

Ocean **EUROPE**
ASIAsert societies and desert environment are not read
Pacific Ocean

Sahara Desert (Hiscock & O'Connor, Chapter 4; A. Smith,

Chapter 14)

AFRICA SOUTH
AMERICA

Indian Ocean
Atlantic Ocean Chapter 13)

NW Coastal Desert (Przywolnik, Chapter 10)

Western Desert (Bird & Bliege Bird, Chapter 5;
Veth, Chapter 6; McDonald, Chapter 7; M. Smith, Chapter 12)

AUSTRALIA
Patagonian Deserts 5000 km
(Borrero, Chapter 8)

Namib & Kalahari Deserts (Widlok, Chapter 2; Hiscock & O'Connor,

Chapter 4;
Thackeray, Chapter 9; Sadr, Chapter 11)

Southern Ocean

Australian Deserts (Widlok, Chapter 2; Hiscock & Wallis, Chapter 3; Paterson, Chapter 15)

AFRICA

Hyperarid
Arid

Indian Ocean

Figure 1.1 Map of world drylands based on UNEP aridity index (after Middleton and **Map of world drylands based on UNEP aridity index . Hyperarid 1⁄4 areas that have very limited and highly variable rainfall amounts, both interannually and on a monthly basis; Arid 1⁄4 areas that have mean annual precipitation up to about 200**
rainfall amounts, both interannually and on a monthly basis; Arid
¼

¼NW Coastal Desert

annual precipitation up to about 200 mm in winter rainfall areas and 300 mm in summer **mm in winter rainfall areas and 300 mm in summer rainfall areas; interannual variability in the 50–100 percent range;**

rainfall areas; interannual variability in the 50–100 percent range; Semi-arid(Przywolnik, ¼ areas withSemi-arid 1⁄4 areas with highly seasonal rainfall regimes and mean annual values up to ca. 800 mm in summer rainfall areas

highly seasonal rainfall regimes and mean annual values up to ca. 800 mm in summer
and ca. 500 mm in winter rainfall areas; high (25–50) percent) interannual variability. (90)
rainfall areas and ca. 500 mm in winter rainfall areas; high (25–50) percent) interannual variability.
_4 _In the absence of any substantial study on hunters-foragers in any part of Pakistan and in the

Chapter 10) –ily accessible to analysis using standard ethno– AUSTRALIA

graphic or historical approaches. For this, the longer

total absence of any pristine area where such aNamib &perspective provided by archaeology is necessary. study could be taken in future, it is time to apply theKalahari DesertsThe emphasis of this chapter is therefore

lessons learnt from other desert areas to this dry squarely on deserts as a major worlds habitat, on

land and wherever possible to reframe questions (Widlok, Chapter 2;hunter-gatherer peoples in deserts, and on the rapabout the structure and dynamicsof foraging idly growing body of archaeological data on the*Southern Ocean* groups, using the desert environment as a frame ofHiscock & O'Connor,deep history of these groups. These studies are

reference and comparison. Deserts have a special particularly pertinent to the situation in ancient Paki

role in human evolution and adaptation. They apChapter 4;stan as most of this region was in fact a desert.Australian Desertspear to be the major terrestrial habitat that chanThackeray, Chapter 9;Deserts are one of the world's major habi neled early human dispersal, representing barriers tat, forming large bands of drylands along the trop(Widlok, Chapter 2;Sadr, Chapter 11)
458 Hiscock & Wallis, Chapter 3; Paterson, Chapter 15)

ics in both the northern and southern hemispheres. A recent map of the extent of world deserts has been produced by UNEP and is reproduced above. Deserts cover approximately 20 per cent of the land area of the world. The boundaries of these drylands are neither static nor abrupt: they have changed throughout the Quaternary in response to shifts in global climate and weather systems – and no doubt will change over the next centuries as humaninduced global warming takes effect.

The defining characteristic of world desert – aridity – can be measured in a number of ways. The current UNEP definition is that it represents a moisture deficit under normal climatic conditions

where rainfall is less than 20 percent of potential moisture loss through evaporation. There is great variability in the intensity of aridity in world deserts. The eastern Sahara in North Africa, the Atacana in northern Chile, and the Namib in southwestern Africa all receive little or no rainfall today and are referred to as hyperarid regions. In these environments life revolves around springs or shallow groundwater seepages, or moisture from coastal fogs. Outside of the scattered oases or well-watered ravines, absolute desert has few resources for a hunter-gatherer population. In contrast, the Kalahari Desert receives relatively good rainfall (250-500 mm per annum) but deep porous Kalahari sands mean that this is quickly lost. The desertland of Pakistan is not as dry as that of the Sahara. There is some rainfall and some underground water is available here and there. In addition, some moisture is available from the waterstreams emanating from the surround hills. Some natural springs are also available. Lakes, fed by overflowing rivers during the flood times are other water resources which the hunter-gatherers people could have utilized for survival. The situation is, however, not uniform; in western Baluchistan, bordering Iran, the whole area is hyper-arid and survival for humans and beast is equally difficult, while in the valleys of eastern Baluchistan some pockets cannot even be categorized as deserts.

Deserts are difficult environments for hunters-gatherers not just because scarcity of water and other resources are limiting factors. These are environments where resources are patchy and highly variable in both time and space. Often small parts of wider landscape – springs, groundwater discharge zones, run-on areas, water streams, lakes, selected areas along the banks of large rivers - are the key to utilization of the wider region. Rainfall events create pulses of biological productivity separated by long dormant periods and these are largely unpredictable in time and space. Desert environments are characteristically subject to high interannual, dedcadal, and millennial variability in rainfall. In deserts, much of the ecosystem is geared towards a pattern of ‘pulse and reserve’ or ‘boom and bust’ that people also use and exploit for their own needs – social as well as economic. Deserts are also highly patchy environments in which nutrients and/or water are concentrated in patches wherein a larger, less productive landscape.

Most desert hunter-gatherers are watertethered to some degree, but in parts of Sindh and Baluchistan, as well as in northern Punjab and the Peshawar Valley, where there are significant plant and animal resources thinly distributed throughout the desert, it is the distribution of small surface waters, seepages, wells, and springs that provides access to the desert hinterland and a means of stepping through the country; like navigating through islands on the sea. Hunter-gatherers in these environments have strategies which involve high residential mobility, broad-spectrum foraging, and a high degree of organizational and technological flexibility.


Mesolithic people of western Sindh may be camping in clusters of huts like this

Generalities about the relationship between the economic/social strategies of human groups and the nature of deserts in which they live provide an insight into the historical patterns of human existence in arid lands. However, the present is not simply an iteration of the past, and explorations of ancient human colonization and settlement of deserts must deal with at least two complexities. First, past environments in which humans lived were often different, sometimes radically so, to those where people were observed in recent times. The opportunities and constraints of those different ecosystems provided the context for early settlement strategies, and archaeological interpretations of past desert lifeways must therefore be set within a framework of the environmental history of each landscape. The second complexity involves the question of what adaptive strategies equipped people to move into deserts for the first time; what kinds of economic tactics had emerged in other landscapes that prepared human groups for survival in the variable and extreme conditions of a desert. A related question is when, and in what conditions, did the economic and social systems visible in historic desert settlement arise; and how far back in time can we recognize those forms of cultural organization?

Critical to any such review is the global timing for desert occupation and what this implies about the competencies of anatomically and culturally modern humans. Do in fact humans occupy deserts early on, or only where these were semiarid and less "marginal" landscapes? Is there evidence for occupation of all desert habitats early on? Are these occupations as early as other modern behaviors, such as the first sea crossings or the earliest dated expression of art?



Grass seeds were an important component of hunter-gathers of the deserts and semi-deserts in the Pleistocene

Another critical issue is the degree to which deserts are actually homogeneous and represent a uniform bloc of physical attributes. Do they have uniform characteristics both across subregions and through time? How real is the concept of the desert culture bloc and the conservative nature of the

societies occupying such a monolithic construct? The studies in Australia, Africa, and the Americas suggest that this assumption needs to be challenged at a number of levels. When an ecological and biogeographic approach is taken in an examination of desert systems, it becomes apparent that adjacent areas are likely to have presented a variety of optimal situations for hunter-gatherers to establish different kinds of habitation loci, to target varied prey, to engage in different *forms* of residential and logistical mobility patterns, and to engage in different rhythms of aggregation and dispersion depending on local and regional climate patterns.

Foragers of Deserts and Semi-Arid Regions: The Aboriginal population of Australia at the time of European contact has been estimated at about a million people. Their society was clanbased, with groups of related clans in language groups, of which there may have been as many as 200. The peoples of the vast arid and semi-arid regions of the interior were generally extremely mobile,

reliant especially on vegetable and seed staples. Edible seeds were collected from more than 70 trees, shrubs, and grasses. One of the most important food sources was *Panicum decompositum,* the so-called native millet of Australia, which was harvested by hand without the aid of any tool, either by stripping the seeds from the plant into a dish, or uprooting the whole plant. The seeds needed to be roasted to remove the husks, so in the first method the seeds were lightly parched in a fire, whereas in the second system the plants were stacked together and burnt and the seeds collected from the ash. Seed-gathering was mostly by hand without tools, but these Australian gatherers then processed their harvests using the same techniques that early farmers used to process their cereals to produce an edible flour: threshing, winnowing, parching, and grinding. Other horticulture-like activities that have been recorded included burning brush to enhance vegetation growth.

Constructing earth dams to divert floodwaters to irrigate land, sowing seeds in places where the plants were not growing to extend their range, and storing seeds to extend the period of their availability. Seeds were stored in a variety of grass, skin, and wooden containers underground; one such store that was observed contained over a ton of seed.

The American Indian tribes of the Great Basin between the Sierra Nevada and the Rockies, such as the Paiute and Shoshone, were also heavily reliant on the collection of grass seeds, and many of their strategies were similar to those of the Australian Aborigines. They harvested seeds by beating the plants with wooden paddles, knocking the seeds into baskets. The seeds were then processed by threshing, winnowing, sieving, parching, and grinding. Seeds were stored in pits, and some groups broadcast seed along stream channels. Mostly the irrigation relied on natural flooding after rains, but in nineteenth century Paiute of the Owens valley are known to have constructed dams and ditches to divert floodwaters onto adjacent land. There has been much discussion about whether the latter techniques were acquired through contact with Spanish or native American farmers, but the balance of probability is that they were not. The cleared and sown plots, like groves of pinyon trees, were generally the communal property of the communities who made them, but there are some indications that ownership may sometimes have been at the household level comthe the



Naturally growing food, like this cactus fruit, could have provided a ready source of carbohydrate and

vegetable protein for the Indus foragers throughout the region

parable with the land tenure systems of most farmers.

The Kalahari San also relied heavily on collecting plant foods. Lee lists 105 plant species that the !Kung-San recognized as edible, fourteen of which were regularly utilized; the rest were collected only if the primary sources failed, or as snack foods. Many nineteenth-century explorers report how Kalahari foragers burnt vegetation especially to encourage the growth of food plants and to remove competing plants, and to encourage young shoots for game. Stands of mongongo trees were protected from such burns by making fire-breaks around them. Other forms of plant manipulation that have been observed include replanting certain species near base camps, and the intentional cultivation of at least one species of melon. The San have also extended the range of the mongongo tree.



A modern village in the dry zone of Sindh

exploitation of favorable patches within a desert environment or whether these areas were semi-arid savannas at that time.

By the Middle Stone Age there is good evidence for establishment of a resident huntergatherer population in southern Sindh. The drylands at the fringes of the Thar were widely occupied by 40,000-30,000 years ago, though the nature of this occupation is still being worked out - and most researchers agree that early settlement may have been patchy and, above all, discontinuous. Any discussion of the initial colonization of deserts now draws on a significant body of archaeological and biological theory about the likely pattern of dispersal into new environments and the use of patchy or mosaic environments such as small oases in extensive deserts. Most deserts have seen periods of enhanced rainfall, fluvial activity, ground water discharges, floods, and greater biological activity in the past. Bridget Allchin has identified and chronologically described one especially ‘wet’ period’ flanked by two usual dry periods in the Thar Desert and the lower Indus Valley (86,94). This has helped shape a fresh and quite elaborate perspective on desert archaeology of Sindh and southeastern Baluchistan.

Natufian Culture at the Paleolithic/ Neolithic Juncture: The Natufian culture in the Near East, is a

known and well-researched primary example of transition from the Paleolithic to the Neolithic, and this evidence is of tremendous help to us in deciphering the process through which hunter-gatherers generally passed through to an economy of agriculture and animal domestication. Termed *complex foragers*, the Natufians are known from many Levantine sites, such as Shubakh Cave, El-Wad Cave, and El-Wad Terrace. Natufian culture emerged around 15,000 BC and constitutes a major

In semi-arid regions of Australia, gathering was increasingly augmented by hunting, fowling, and fishing. The Bagundji of the Darling basin in New South Wales, for example, had developed highly specialized fishing techniques using stone traps and wickerwork weirs, and waterfowl were trapped with large nets strung over rivers. In southern California, too, the tribes planted maize, beans, and squash, but they relied for their liveli hood more on hunting, fishing, shellfish collection, and plant gathering.

Inferences for Paleolithic Subsistence in Pakistan: When did people fist settled Paki stan? Archaeological evidence indicates that



people have a long presence in the drylands of **A modern settlement in Noshki Desert, Baluchistan** Pakistan, not only in northern Punjab but also in Sindh. Early Stone Age or Acheulian sites are re

ported from the lower Indus Valley, where they turning point in human prehistory because it proare associated with ancient Indus courses and lake vides the earliest signs of food plants domesticadeposits but also in Pothwar where they are assocition. Natufian sites range in

size from small baseated with water springs and seepage water, and camps to quasi-villages. The villages contain dwellsmall rivers like the Soan, Haro and Nandna. One ing structures, stone tool industries including newof the perennial difficulties with the interpretation of tool types of picks and sickles, animal bone tools,such data is in determining whether this reflects and grinding tools. Graves are found in all the larger settlements. They often contain more than one individual and thus provide the first evidence of cemeteries. Several burials with the skull removed have been found, and many skeletons are decorated with shells, bones, and animal tooth pendants. This evidence indicates a social pattern of treatment of the dead, perhaps involving beliefs about an afterlife or supernatural realm. It would not be surprising if the foragers of Baluchistan and western Sindh also passed through a similar process to the culture of the Neolithic.

The seasons would have been marked by alternating dry and cold periods, inflicting considerable stress on humans. This has been indicated by deep sea cores obtained from the Indus Delta. It is presumed that one way of dealing with such environmental stress was the adoption of semipermanent residence in one place, with more substantial dwellings. Deliberate management of plant and animal food resources would have supported a sedentary lifestyle by providing more dependable, local food sources. Microscopic studies of the edges of Natufian sickles show that they were used to harvest wild cereals. Natufian people used large stone mortars to grind wild grains - the first evidence of cereal processing. In the Zagros mountains the Mesolithic people began to manage animal populations through selective hunting practices.



A village scene from Cholistan Desert

Selective killing of adult male gazelles indicates that people were deliberately removing non-reproductive members of the herd to ensure that herd size and survival would not be jeopardized.

During this period human populations in many areas began to exploit a much wider range of foodstuffs, a pattern of exploitation known as broad spectrum economy. Intensively exploited foods included wild cereals, seeds and nuts, fruits, small game, fish, shellfish, aquatic mammals and birds, tortoises, and invertebrates such as snails. At this time, the Levant was rich in plant species but not in maritime resources. Dogs were domesticated in this period, probably for use in hunting. Some late Paleolithicc hunter-gatherers appear to subsist on hunting of gazelle as well as harvesting of wild cereals.

Toward Sedentism and Agriculture - Evidence from Pakistan: Direct evidence for Paleolithic-Neolithic transition from Pakistan is not available but a lot can be extrapolated from the early human settlements in the Near East. This information is substantially augmented by the discoveries at Mehrgarh, on the border of Sindh and Baluchistan. The earliest section of this site represents a sedentary, non-ceramic culture (before the invention of pottery). At Mehrgarh, these people were already agriculturists and pastoralists. It appears that with the warmer and moister conditions of the Holocene, dense woodlands with heavy concentrations of nut bearing trees and shrubs emerged. On marginal lands, jajube (*ber*) shrubs appeared. These provided the Mesolithic and early Neolithic people with

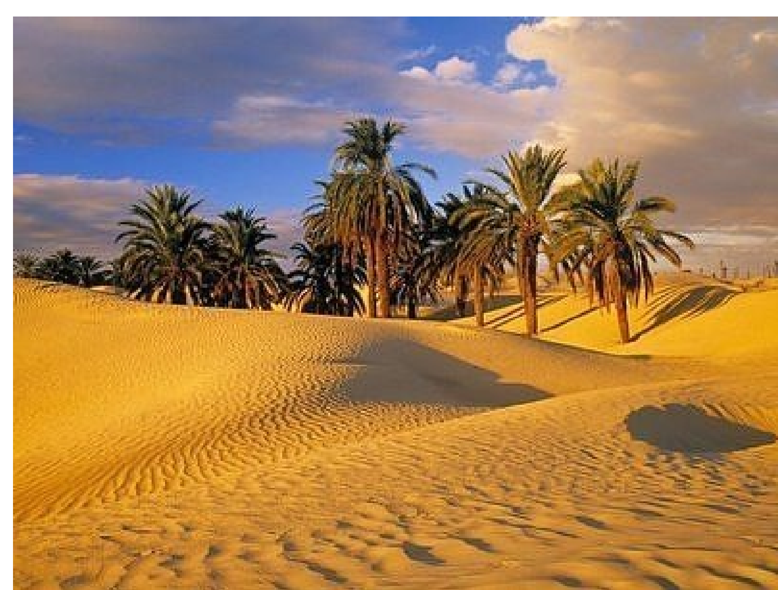


A modern settlement in the Thar Desert

nutritious food which could be collected and stored. At Mehrgarh's early stratum, grape pits were

also discovered. Expressive culture and art were not entirely absent, as evidenced by many examples of jewelry and beads in its lower stratum. Around 10,000 years ago, and for about 600 years, a cultural mosaic existed: a foraging economy combined with permanent settlement and decorative art. Residential quarters consisted of very small rooms, not connected with one another, made of mud and without any lateral entrance. It is surmised that these rooms were basically used for storage rooms, their entry being through the roof.

There is strong evidence that during the Mesolithic transition in the late Pleistocene the Indus people had started to use bow and arrow and had possibly learnt to trap animals and birds. There is also some indication that they were already in possession of the fishing net, which they probably fashioned from cordage of high tenacity grasses, strips of animal hide, or gut. Their keen observation of animal behavior, generation after generations, must have taught them about the feeding habits of the game and this pool of knowledge they must have used to their advantage in improving their hunting and scavenging efficiency. Similarly, they were gathering knowledge about different plants in their close proximity; which factors promoted their growth and what elements helped them yield increased amounts of seed, i.e., the grain. Thus, their hunting and sc.avenging efficiency was improving and so was their dexterity in food gathering.


An oasis in the desert

These living conditions also accelerated the processes through which domestication of animals and plants could be attempted. It appears that while some hunters and gatherers continued to move seasonally to optimize the use of different sources of food, some bands of hunters and gatherers stayed put within a small geographical area or even at fixed locations. It must be remembered that the life in the Mesolithic periods was still generally one of movement from place to place on a seasonal basis in the timehonored way. Human communities were small, probably less than a hundred, though a given region might at times support a considerable number of their settlements. Western Sindh and eastern Baluchistan were particularly suitable for such congregations because of the availability of fresh water round the year and plenty of game on the slopes of the surrounding hills.

The stone tools found at various sites form the chief evidence of the subsistence pattern of the Mesolithic people in Sindh, southeastern Baluchistan, and the Peshawar Valley (the Sanghao Caves). This evidence is supplemented by the depiction of scenes of hunting, fishing, trapping of mice and plant food collection in the contemporary rock paintings in the Kirthar Range. Faunal evidence is, however, missing altogether.

The makers of these tools lived in a landscape that must have been much like areas of plains covered by dry grass, with occasional *acacia* thorn bushes, alternating with open woodland, largely *acacia* but including other small and medium sized trees, and a certain amount of relief in the form of rocky hills and fossil dunes. Nilgai, spotted and other types of deer are still fairly common in the region today and until this century were prolific; the Indian rhinoceros and the Gir lion, now extinct, and many other species must have shared it with them. There is little doubt that the stone artifacts we find today formed a small but important element of Mesolithic hunting equipment which by this time would certainly have included the bow and arrow.

We have no direct evidence in Pakistan, or for that matter in India, for hafted stone artifacts, as we have in Europe and Southern Africa but there is a steadily growing body of circumstantial or indirect evidence in the form of rock art. The proliferation of microliths is, however, a strong indication that composite tools must have existed as micrioliths can hardly be used as such. Further evidence comes from the early Neolithic site of Mehrgarh where hafted tools, such as saws and sickles have been found. In the type of environment the Dry Zone provided, some sort of missile with a fairly long range would have been an essential part of the hunters equipment and, thus, it can be safely surmised that bow-and-arrow and stone-tipped spears were used.


A burst of vegetation around a water stream in Pothwar

Lithic evidence from Lower Sind and Lasbela shows that a life-style established in the Upper Paleolithic continued without a break until the the fifth or sixth millennium B.C. when microliths start proliferating and signs of semi-permanent campsites start appearing around lakes and freshwater springs. Similar developments probably took place in other parts of the country as well, although at somewhat slower pace and in a different time frame. For example, the northern parts went through

this transition between the fourth and the third millennium B.C. We do not know much about Punjab proper as no Paleolithic or Mesolithic site has so far been discovered in this part of the country. There are, however, a number of sites, discovered by Mughal, in Cholistan Desert (Bhawalpur Division) which show a robust population with a Mesolithic culture all over the area but especially along the ancient course of the river GhanaarHakra. These settlements are not the outgrowth of the earlier Paleolithic campsites but rather fresh settlements, probably by the expanding population of the Lower Indus region into this region. These sites have been dated to *ca.* 4,000 B.C.

The survey of the cultural and historical geography of Baluchistan, Sindh, and the northern areas reveals the natural variables that would have provided the subsistence economy of the region. In the late Pleistocene, there was abundant game: wild sheep, goats, pigs and gazelle were plentiful in the foothills of Baluchistan, the Pashtun country and Pothwar plateau. Wild cattle, including buffalos, must also be present, especially in the plains of the Indus. Places like Manchhar Lake and the lakes formed by several mountain streams and swollen rivers must be teeming with fish. Grain was available from several grasses, the most important of which was wild barley. Wild pistachios, prunes, almonds, and *bers* were present in the valleys of Baluchistan. The hard evidence comes from the extrapolation of lowest stratum of Mehrgarh.

Notwithstanding the lack of archaeological evidence, coastal areas must be exploiting the resources from the sea. Recent research has discovered several shell middens around Thatta, dating around 4,000-5,000 years B.C. which provides proof for the utilization of water resources for by the inhabitants of this area in the Mesolithic stage of their development. Besides this, we practically know nothing about the subsistence and lifestyle of these people. Some information has been gathered from other primitive cultures and extrapolated to the conditions of this period in Pakistan. For examples, Fairservis has provided an archaeological picture of subsistence activities of people living in a comparable stage of development in the Middle East and on the studies of the living hunting-gathering bands in India, Africa, and Australia.

At the risk of generalization, huntinggathering populations had spread into most of the habitable regions of Pakistan where water was available from river streams or natural springs and game was to be had aplenty by 300,000 years ago. By 10,000 to 15,000 years ago at the latest, they were beginning to settle down on the slopes of the Quetta Valley. With the aid of their flexible hunting and gathering techniques and rapidly evolving toolmaking technology, these groups, loosely organized as small bands of hunters and gatherers, were able to adapt to virtually all the climatic zones and environmental niches in the region, from the arid zone of Cholistan to the temperate climate of western foothills, to the cold climate of Swat and Kashmir, to the hot and dry valleys of Baluchistan, to the plains of rivers in Punjab, and to the coastal regions in the south. This settlement pattern is no different than that observed in the Near East with which the environment of Pakistan’s drylands many ways.

Neolithic Settlement of hunting-gathering culture of late Pleistocene gave way to the Neolithic, a stage of development when ground stone tools and pottery appeared, the domestication of plants and animals was undertaken, and man started to live in permanent or semipermanent settlements. In Pakistan, we have robust evidence of this stage of cultural development in the Kachi plains on the border of Sindh and Baluchistan. Here, at Mehrgarh, the bones of presumably domesticated animals have been found mixed in with those of wild animals at the earliest stages of the settlement. As the settlement matures, the proportion of wild animal bones decreases and that of the of the domesticated

animals increases, signifying the transition from a predominantly huntergatherers subsistence to that of agriculture and animal herding.

The development of agriculture concurrently with the beginning of settled life seems to be the norm all over the ancient world but as we learn more about prehistoric human life, it is becoming clear that there were many parts of the world where the initial appearance of domesticated plants and animals was uncorrelated with the particular types of material culture that we define as Neolithic. Permanent settlements occurred without the development of agriculture and animal domestication. The latter has been the case particularly with a major part of the present day India and probably in the coastal regions and marshy lands of Sindh. The Volume II (*A Prelude to Civilization*) of this book covers this stage of development in details. corresponds in

Pakistan: The

VIII.5. References

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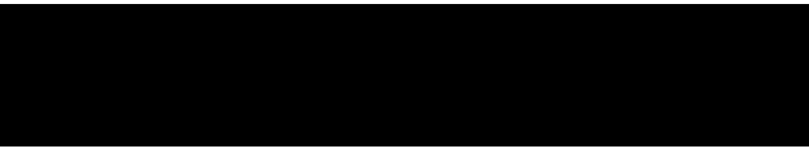
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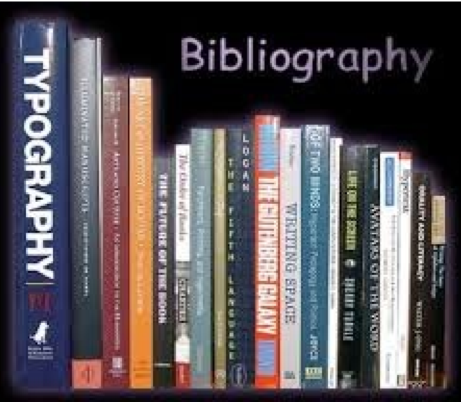
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SECTION IX.

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IX.2. Glossary

Absolute dating: Fixed dates which are usable world-wide; e.g. those obtained by radiocarbon.
Acheulean : A stone tool industry, in use from about 1.6 million years ago until 125,000 years ago. It was characterized by large bifaces, particularly hand axes. This tool-making technology was a more complex way of making stone tools than the earlier Oldowan technology. More flakes were knocked off from both sides of a stone and there is evidence that the maker had a preconceived notion of the tool's final form
Abrupt Climate Change: Sudden (on the order of decades), large changes in some major component of the climate system, with rapid, widespread effects.
Adaptation: Adjustment or preparation of natural or human systems to a new or changing environment which moderates harm or exploits beneficial opportunities.
Allele: An alternative form of a gene; any one of several mutational forms of a gene.
Alluvial Deposit: Soil deposited by running water, such as streams, rivers, and flood waters. Many ancient peoples, such as the Indus people living along the Indus and its tributaries, depended on annual floods and alluvial deposits to replenish the soils they were farming.
Anatomy: The biological structure of an organism. **Artifact:** A thing that has been manufactured or intentionally modified for some use. Stone tools such as handaxes are examples of artifacts.
Assemblage: A group of objects found together. **Archaic Homo sapiens:** The variety or species of humans that was intermediate between Homo erectus and modern people (Homo sapiens). The first archaic Homo sapiens may have evolved as early as 650,000 years ago, but most lived after 300,000 years ago. The last and most well known of them were the Neandertals, who survived until nearly 28,000 years ago. Archaic Homo sapiens have also been referred to as "archaic humans" and "early Homo sapiens.
Australopithecus: Any of various extinct apelike primates of the genus *Australopithecus* and related genera, remains of which have been discovered in southern and East Africa. Some species are estimated to be over 4.5 million years old
Autosome : A nuclear chromosome other than the X- and Y-chromosomes
Baysian analysis: a mathematical method to further refine recurrence risk taking into account other known factors.
Behavioral ecology: A heuristic approach based on the expectation that Darwinian fitness (reproductive success) is improved by optimal behavior. **Blade:** A relatively long thin flake with parallel to sub-parallel sides and a length generally at least twice its width. A hallmark of mode 4 technology, blades are usually detached from prepared cores. In some variants, the resulting core resembles a prism (or cone).
Biface tools: Stone tools that have been worked on both sides or faces, meaning that flakes have been intentionally (not naturally) chipped off from both sides of the stone.
Bottleneck effect: A dramatic reduction in genetic diversity of a population or species resulting from an ecological crisis that wipes out most of its members. The limited genetic diversity of the few survivors is the pool from which all future generations are based.
Bulb of percussion: A small, rounded protrusion on a flake resulting from the blow that separated the flake from its core or another flake.

Carnivorous: eating only meat. Animals that have this sort of diet are carnivores.
Chert: Extremely fine-grained siliceous rock occurring naturally, often worked to form tools.
Chipped stone: stone worked by percussion or pressure flaking (tool knapping)

Conglomerate: A coarse-grained sedimentary rock consisting of round rock fragments cemented together by hardened silt, clay, calcium carbonate, or a similar material. The fragments (known as clasts) have a diameter of at least 2 mm (0.08 inches), vary in composition and origin, and may include pebbles, cobbles, boulders, or fossilized seashells. Conglomerates often form through the transportation and deposition of sediments by streams, alluvial fans, and glaciers.
Core: A rock from which flakes are purposefully detached. Some cores can also be used as heavyduty tools (i.e., for smashing, chopping, bulk cutting, etc.), especially when dealing with mode 1 & 2 technologies.
Cortex : The rough outer surface of a stone, usually removed to reveal the smooth interior during flint knapping (the making of stone tools).
Cranial capacity: the volume displaced by the brain within a cranium , or skull case. Cranial capacity is a simple measure of brain size but not necessarily of intelligence.
Chromosomes: DNA molecules do not float freely about in our bodies; they are located on structures called *chromosomes* found in the nucleus of each cell. Chromosomes are nothing more than long strands of DNA, covered with some kind of protective protein coating.
Cleaver: A large cutting tool, somewhat flattened in cross-section and u-shaped in outline, with a broad, unworked, transverse cutting edge at the distal end (i.e., at the open end of the ‘u'). The broad transverse working edge contrasts sharply with the pointed tip found at the distal end of handaxes and picks.
Culture: Shared learned beliefs, behaviors, customs, practices, etc.

Debitage: Debris from tool knapping activities. **Diffusion**: The transmission of ideas or materials from culture to culture, or from one area to another. **Deletion**: the loss of a segment of the genetic material from a chromosome

Ethnography - A branch of anthropology that studies and describes modern human cultures (rather than human behavior or physical attributes). Archaeologists sometimes work with ethnographers in an effort to correlate behavior with material remains. **Earlier Stone Age (ESA):** A prehistoric Period. An assortment of prehistoric technologies common to some areas of Africa ~2.6 million years ago to ~200,000 years ago, characterized by the production and use of mode 1 and/or mode 2 technologies to the exclusion of all others.
Eurasia: The landmass that incorporates both Europe and Asia.
Evolution: ‘Change in the inherited traits of a population through successive generations
Extant: ‘living' or ‘existing'.
Extinction: Occurs when the death of last individual of a species perishes; it is the end of the organism and the taxa in which it belongs.
flake: A piece of rock detached from a core through the process of knapping.
forage: To search for food, water, supplies, provisions, etc.
Flint - Hard, fine-grained sedimentary rock used by early humans to manufacture stone tools, such as spear and dart points, knives, and other utilitarian tools. Late stone-age people also struck flint to make sparks to produce fire.

Gauss-Matuyama Reversal: A geologic event approximately 2.588 million years ago when the Earth's magnetic field underwent reversal. **Genes:** DNA is made of a sequence of simple units, called *genes*, the order of these units spell out instructions in the genetic code.
Gene flow - the flow of genes from one population to another.
Genetic drift - the change of gene frequency from one generation to another caused by the

cumulative effects of random fluctuations, rather than by natural selection.
Genome: The full genetic complement of an individual (or a species). In humans, it is estimated that each individual possesses approximately 3 billion nucleotides in all of the DNA that makes up his or her Gene flow**:** The transference of genes from one population to another, usually as a result of migration. The loss or addition of individuals can easily change the gene pool frequencies of both the recipient and donor populations.
Genetic Drift: Evolution, or change in gene pool frequencies, resulting from random chance. Genetic drift occurs most rapidly in small populations. In large populations, random deviations in allele frequencies in one direction are more likely to be cancelled out by random changes in the opposite direction.
Genetic Screening: Testing groups of individuals to identify defective genes capable of causing hereditary conditions.
Genetic Admixture: Admixture occurs when individuals from two or more previously separated populations begin interbreeding. Admixture results in the introduction of new genetic lineages into a population.
Genome: All of the genes carried by a single gamete; the DNA content of an individual, which includes all 44 autosomes, 2 sex chromosomes, and the mitochondrial DNA
Gene Pool: all of the genes in all of the individuals in a breeding population. More precisely, it is the collective genotype of a population.
Genetic diversity: The existing genetic variation within a population.
Great Rift Valley also **Rift Valley:** A geologic depression of southwest Asia and eastern Africa extending from the Jordan River valley to Mozambique. The region is marked by a series of faults caused by volcanic action
Gracile: Graceful, slender, and delicate. This 17th century English term is used to describe the body characteristics (especially bones) of the early australopithecines and the earliest humans.

Herbivorous: eating only vegetable foods. Animals that have this sort of diet are herbivores or vegetarians. See carnivorous and omnivorous. **Homo** *the genus in which all humans are classified.*
Hominid - This term was used in the past to describe the early humans called Hominins today. When the classification system changed to include apes in the human lineage (Hominidae), the term Hominid came to include apes and humans. Today, when talking about the human lineage and its ancestors, we use the term Hominin. Older publications that use the term Hominid are usually referring to the human lineage only.
Hunter-gatherers *:* A community or group that subsists primarily by hunting wild game and gathering wild plant resources.
Habitat: The physical environment (i.e. the natural resources and physical conditions) of an organism or organisms. **Source**: © 2010 Nature Education Knowledge.
Hafting: To attach one or more tools together (e.g., using animal sinews and a primitive glue to attach [‘haft'] a stone spearhead to a wooden shaft). **Hammerstone:** A rock used to detach flakes from cores.
Handaxe: A large cutting tool, somewhat flattened in cross-section and roughly teardrop-shaped in outline. Handaxes have a series of flake removals along both side margins, creating a pointed tip and a pair of long cutting edges.
Hominin: Modern humans and our **extinct** kin that are more closely related to us than to modern chimpanzees
Heterozygosity: A measure of genetic diversity **Holocene:** The more recent of the two epochs of the Quaternary Period, beginning at the end of the last major Ice Age, about 10,000 years ago. It is

characterized by the development of human civilizations. Also called *Recent*. See Chart at geologic time.

Interglacial: A long, period of warmer conditions between glacials when the earth's glaciers have shrunk to a smaller area. Pleistocene Epoch lasted years. We are probably in an interglacial at present. Interglacials during the 10's of thousands of

Knap: To purposefully detach a flake and/or shape a core.

Later Stone Age (LSA): A prehistoric Period. An assortment of prehistoric technologies common to some areas of Africa ~50,000 years ago to recent times, characterized by the production and use of modes 1, 2, 3, 4, & 5 lithic technologies. Mode 5 technologies (geometric microliths) are particularly emphasized. In addition, the LSA is characterized by the widespread use of jewelry, ochre (for paint and glue), bone tools, etc.
Law of Superposition: A physical "law" asserting that deeper layers of sediment or archaeological strata will naturally be older than the layers above them (in the absence of unusual, disruptive, activity, such as earthquakes)
Levallois technique - A tool-making technique that originated 200,000 years ago in which a prepared core was used to manufacture flakes of predetermined size and shape. Characteristic of Middle Paleolithic and Mousterian technologies.

Marker : a gene with a known location on a chromosome and a clear-cut phenotype, used as a point of reference when mapping a new mutant.
Mesolithic: The period between the Paleolithic (older) and the Neolithic (younger) Ages.
Midden: A deposit of occupation debris, rubbish, or other by-products of human activity, such as shell, bone, or debitage, found close to a living area; a trash heap or pit.
Mousterian:The name given to a European stonetool industry characterized by flakes struck from prepared cores, dating from about 150,000 until 35,000 years ago.
Mutation -- process by which genes undergo a structural change.
Microliths: Relatively small flakes commonly produced in standardized geometric shapes (trapezoids, crescents, etc.). Microliths were embedded in shafts and handles to create the sharp cutting edges of knives, sickles, arrows, etc.
Middle Paleolithic (MP): A prehistoric Period. An assortment of prehistoric technologies common to some areas of Eurasia and Australia from ~250,000 years ago to less than ~10,000 years ago, characterized by the production and use of modes 1, 2, & 3 technologies to the exclusion of all others. Mode 3 technologies are particularly emphasized.
Middle Stone Age (MSA): A prehistoric Period. An assortment of prehistoric technologies common to some area of Africa from ~300,000 to ~30,000 years ago, characterized by the production and use of modes 1, 2, & 3 technologies to the exclusion of all others. Mode 3 technologies are particularly emphasized. The MSA also contains early examples of mode 4 and 5 technologies.
Modes of lithic technology: A hierarchy of basic strategies underlying stone tool production, focusing on the relationship(s) between cores and flakes, as well as the desired end product(s). Modes are categorical and progressive (i.e., they build upon technological advances made in previous modes). **Mode 1:** Lithic technology involving the production of relatively unsophisticated non-standardized core and flake forms. Flakes are rarely sharpened or secondarily shaped. Some core forms may serve as heavy-duty cutting or bashing tools.
Mode 2: Lithic technology involving the production of large cutting tools (LCTs) through the

purposeful shaping/knapping of stone. While LCTs primarily serve as heavy-duty cutting implements, they may also serve as basic core forms from which useable flakes are knapped.
Mode 3: Lithic technology involving the production of relatively standardized flake forms through the planned prior shaping of cores (i.e., through the use of 'prepared cores'). Once obtained, targeted flakes can either be used 'as-is', or be modified into more specific 'flake tool' forms (e.g., a particular type of scraper, point, etc.). Prepared cores are generally not used for tasks other than flake production. **Mode 4:** Lithic technology involving the production of relatively standardized blade forms through the planned prior shaping of cores (i.e., through the use of 'prepared cores'). Once obtained, blades can either be used 'as is', or be modified into more specific tool forms. Many blades are eventually incorporated into compound tools (e.g., knives, etc.). Prepared cores are generally not used for tasks other than flake production.
Mode 5: Lithic technology involving the production of relatively standardized microlith forms through the planned prior shaping of cores (i.e., through the use of 'prepared cores'). Once obtained, microliths can either be used 'as is', or be modified into more specific tool forms. Many microliths are eventually incorporated into compound tools: knives, spears, arrows, sickles, etc. Prepared cores are generally not used for tasks other than flake production. **Morphology:** Refers to form or structure.
Mitochondrial DNA - the DNA found only in the mitochondria (the powerhouses of the cell) and inherited only from the mother.
Radiocarbon: isotope of carbon (Carbon 14) used to obtain absolute dates for organic materials (anything that was once alive, e.g. wood, bone). **Relative Dating** - A system of dating archaeological remains and strata in relation to each other. By using methods of typing or by assigning a sequence based on the Law of Superposition, archaeologists organize layers or objects in order from "oldest" to "most recent." Relative dating methods help archaeologists establish chronologies of finds and types.
Recessive: a gene that is phenotypically manifest in the homozygous state but is masked in the presence of a dominant allele
Retouch: Purposeful knapping along the edge of a tool, usually to produce a sharper working edge.

Old World - Regions of the world (Europe, Asia, Africa) known to Europeans before the discovery of the New World (Americas) by Christopher Colombus.
Oldowan: An Earlier Stone Age/Lower Paleolithic tool industry characterized by the production and use of mode 1 technology to the exclusion of all others. The Oldowan is replaced by the Acheulean industry (with mode 2 technology) ~1.7 millionyears-ago.
Organic: Material derived from or relating to living organisms. Organic remains decay and are not preserved as well as inorganic remains in the archaeological record.
Omnivorous: the ability to live by eating both meat and vegetable foods.

Paleobiology: The study of past biological systems.
Paleoanthropology - the study of human origins, the study of the fossil and cultural remains of extinct human ancestors.
Phenotypic Characteristic: such traits which are manifested due to the combined action of inherited genes and environmental circumstances are called as *phenotypes*.
Pleistocene: The earlier of the two epochs of the Quaternary Period, from about 2 million to 10,000 years ago. The Pleistocene Epoch was characterized by the formation of widespread glaciers in the Northern Hemisphere and by the appearance of humans. Mammals included both small forms, such as saber-toothed tigers and horses and giant ones, such as mammoths and mastodons. Almost all the

giant mammals, including woolly mammoths, giant wolves, giant ground sloths, and massive wombats disappeared at the end of the Pleistocene and the start of the Holocene.
Pliocene: relating to or denoting the last epoch of the Tertiary period, between the Miocene and Pleistocene epochs.
Provenance: The origin, or history of ownership of an archaeological or historical object.
Symbolic thought: The ability to manipulate and use abstract concepts (e.g., words, numbers, symbols, gestures, etc.) to represent events, people, places, or things — including other abstract ideas (love, freedom, etc.
Steppe: vegetation consisting of grasses and other herbaceous plants, such as yellow asphodel and thistles
Scraper: A tool form produced by retouching a flake into a relatively specific shape optimal for scraping flesh from hides, woodworking, etc.
Sediments:Soils that have been transported over distances and have accumulated in a new area
Settlement pattern - Distribution of human settlements on the landscape.
Stratigraphy - The study of the layers (strata) of sediments, soils, and material culture at an archaeological site (also used in geology for the study of geological layers).

Taxonomy - the classification of organisms into groups according to their relationships and the ordering of these groups into a hierarchical arrangement.
Temperate: referring to climatic regions in between subtropical and subarctic zones. Temperate areas usually have winter snow and are too cold to grow oranges and avocados
Trait: any detectable phenotypic property of an organism.
Tufa: Solidified volcanic ash. Also known as tuff. **Typology:** system of classifying artifacts by physical appearance.

Upper Paleolithic (UP): A prehistoric Period. An assortment of prehistoric technologies common to some areas of Eurasia, northern Africa, and Australia from ~50,000 years ago to nearly historical times, characterized by the production and use of modes 1, 2, 3, 4, and (eventually) mode 5 lithic technologies. Mode 4 technologies (blades, etc.) are particularly emphasized. In addition, the UP is characterized by the widespread use of art, bone tools, etc.